ume 18 Number 5

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May • 1933

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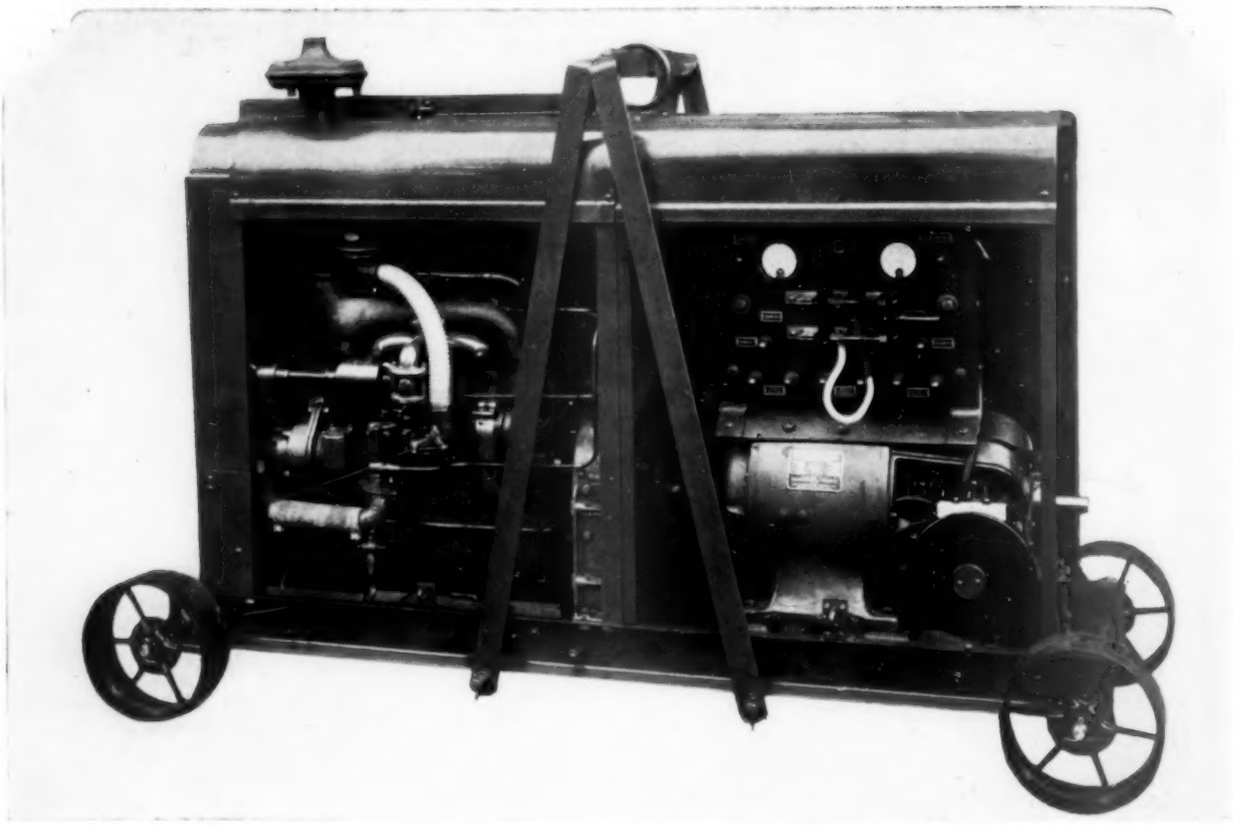

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THE WELDING ENGINEER

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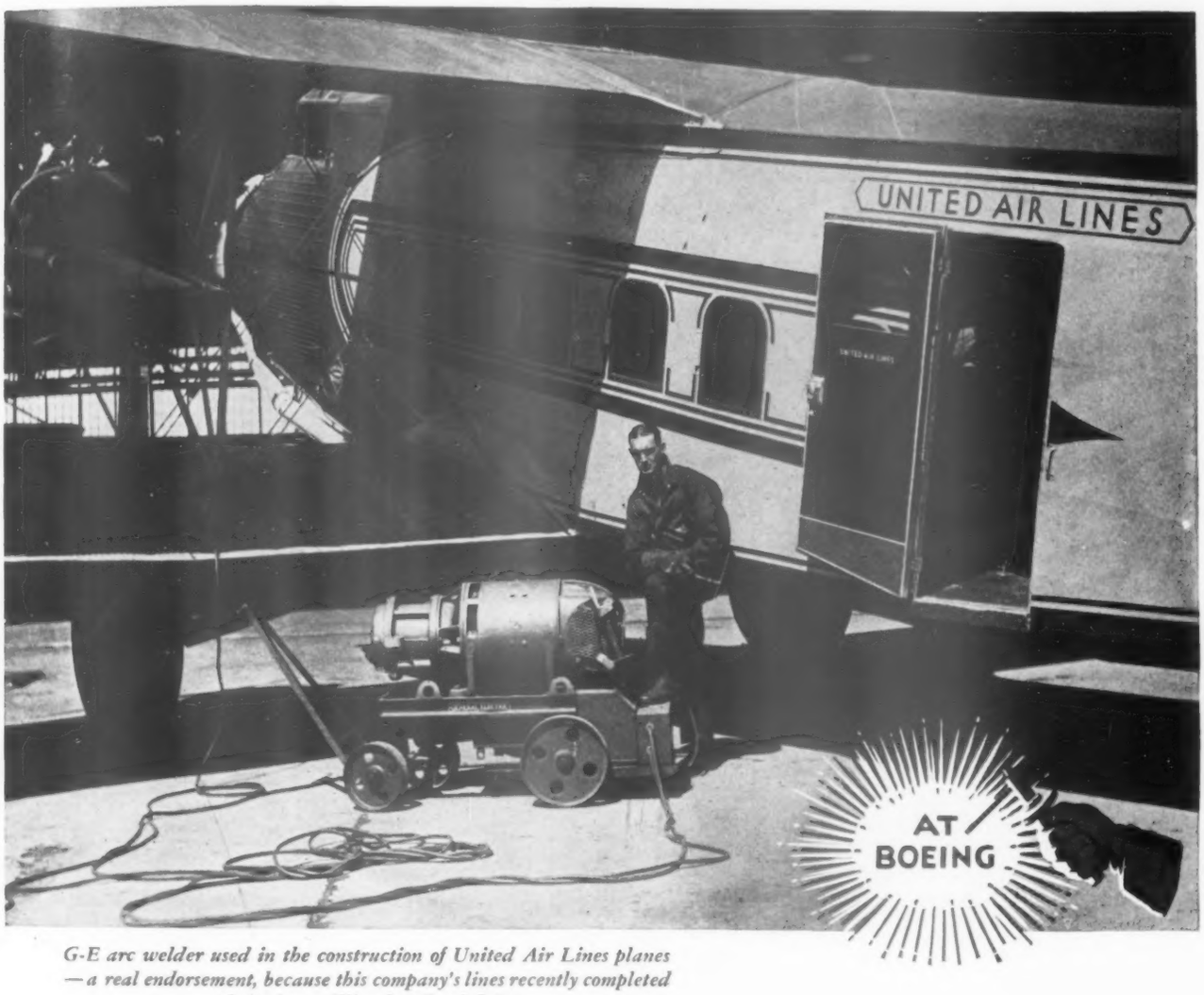
"PERFORMANCE OF G-E ARC WELDER (AT BOEING) IS OUTSTANDING"



G-E arc welder used in the construction of United Air Lines planes —a real endorsement, because this company's lines recently completed their sixty-millionth mile of flying

"FOR the last ten years," says Mr. W. A Peseau, "I have been employed by the Boeing Airplane and Air Transport Companies. During that time I have worked nearly every a-c. and d-c. welder on the market. The performance of the new G-E welder that we recently purchased is outstanding. Incidentally, this welder played an important part in the construction of the new Boeing twin-engined passenger-cargo transport we built for the United Air Lines."

Need you look any farther for your next welding set? You'll find everything you want in the G-E Type WD arc welder—flexibility, "pep," stability, compactness, easy operation. Why not let our nearest welding distributor or sales office show you this fine machine in action? Test it, yourself, and be convinced.

Remember, you can buy everything you need — welders, electrodes, accessories, cable —on one order blank from one dependable manufacturer. General Electric, Schenectady, N. Y.

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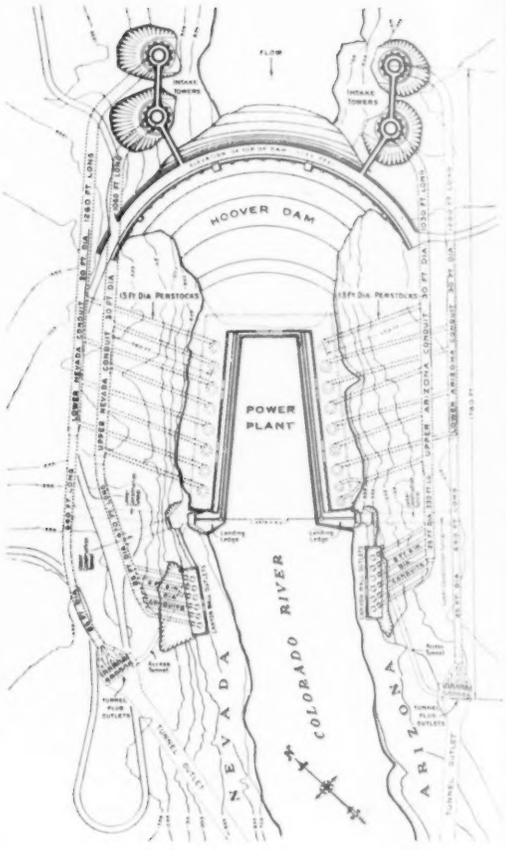
GENERAL ELECTRIC



Drawing Showing Location and Extent of Fusion-Welded Piping.

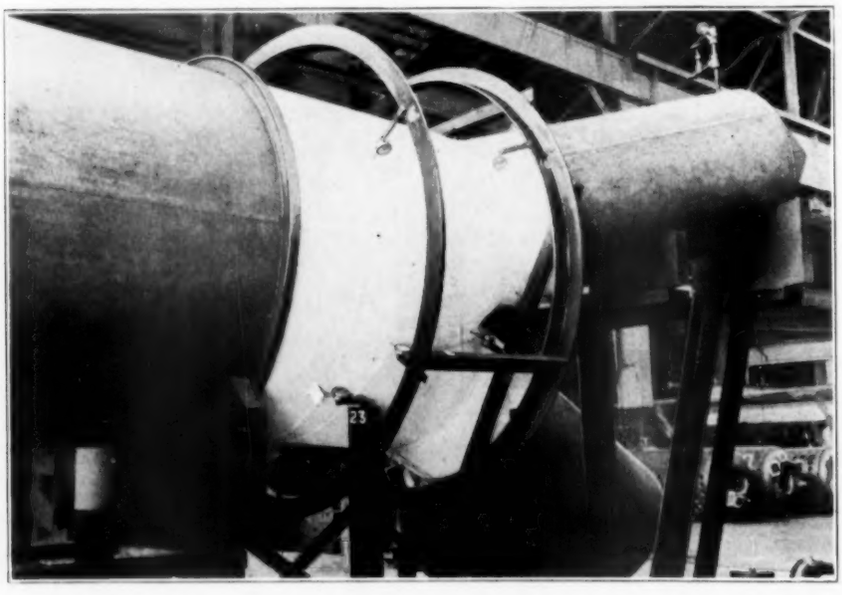
Boulder Canyon Project *to require* 45,000 Tons of Welded Steel Pipe

THE installation of fusion-welded plate-steel pipes in the hydraulic-power and outlet-works tunnels at Hoover Dam, a part of the Boulder Canyon project, is one of the most authoritative of endorsements of welding in engineering construction. The contract for this work, awarded to The Babcock & Wilcox Co. by the Bureau of Reclamation, U. S. Department of the Interior, involves the construction of pipes larger than any ever made, the transportation and handling of pipe sections as heavy as many types of standard gage railroad locomotives, and the exploration of the welded seams by X-ray equipment of a capacity and power made available only within the last year.

The piping will consist of four main conduits with branches leading to the power house, canyon-wall outlets and to tunnel-plug outlets, as shown by the diagram. The approximate sizes of the pipes to be fabricated are:

Length, ft.	Dia., ft.	Plate Thickness, in.
4700	30	1¾ to 2½
1900	25	1⅛ to 2⅛
5600	13	1 to 1⅛
2300	8½	⅞ to 1

A total of 45,000 tons of steel will be used in fabricating the 14,500 ft. of pipe.



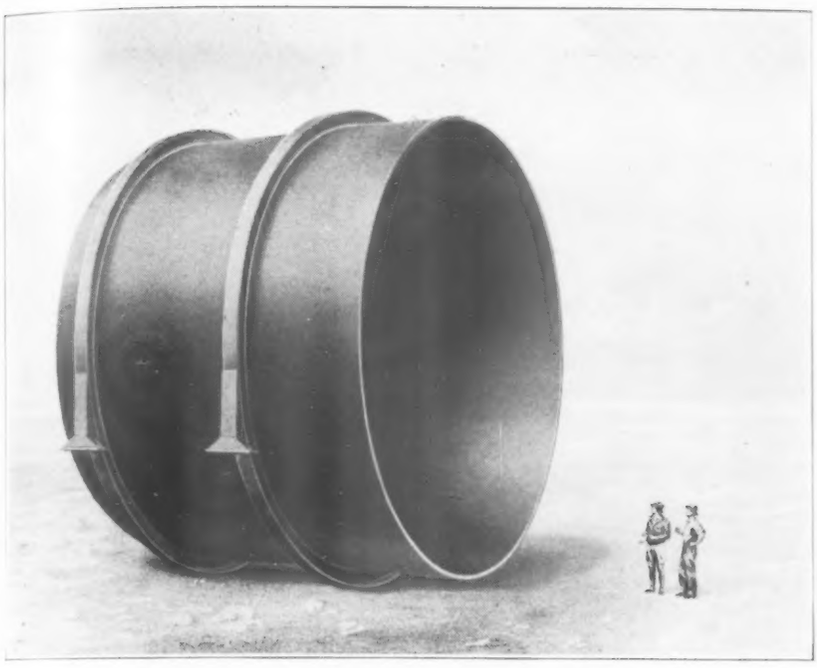
Test Model, One-Sixth the Full Size of a 30-Ft.-Diameter Pipe Section, With Micrometer Gages Arranged to Show the Deflection of the Pipe Walls Under Pressure.

Piping Too Large to Be Shipped by Rail

As the diameters of most of this piping are too great to permit shipment by railroads, a fabricating plant has been erected about a mile from the site of the dam. This plant is complete in every respect from plate-bending rolls to a laboratory for testing weld specimens.

A clear idea of the magnitude of the fabricating work may be obtained from the fact that one piece of 30-ft.-diameter pipe approximately 12 ft. long will be made from three steel plates, each about 32 ft. long and 12 ft. wide, the largest that can be rolled with existing steel-mill equipment and so heavy that, in many cases, only two plates can be shipped to the fabricating plant on one railroad car.

Two pieces of 30-ft.-diameter pipe, each about 12 ft. long, when welded together will comprise an erection-section which, with support brackets and stiffening rings, will weigh, when made of plate



The Comparative Size of a Man and a Section of the 30-Ft.-Diameter Pipe Is Strikingly Illustrated in This Drawing.

of the maximum thickness required, about 150 tons.

The plates, after being formed, will be joined by fusion welding and in accordance with the rules of the A. S. M. E. Boiler Construction Code, Unfired Pressure Vessel Section for Class 1 Welding. Over 400,000 lineal feet of welding will be performed.

Record Quantity of X-Ray Film

Various tests of the finished sections will be made, including X-ray examination of the most searching character. Incidentally, the quantity of X-ray film to be used in the examination of the seams of these pipes will exceed the total of that produced to date for all industrial purposes.

Automatic Welding Will Be Employed in Fabricating the Huge Pipes.

Los Angeles Section Holds Interesting April Meeting

Preceded by the usual 6 o'clock dinner at the Mona Lisa Cafe on Wilshire Blvd., a meeting of the Los Angeles Section of the American Welding Society was held on April 20th. Due to the unsettled state of affairs and business in general in March, following the earthquake in that area and the "banking holiday," the March meeting of the society was cancelled.

A very interesting program was given at the April meeting, the first feature being a paper prepared by C. E. Olmstead, engineer for the Mahr Manufacturing Company, of Minneapolis, Minn., on "Stress Relieving Furnaces for Large Welded Pressure Vessels," which was read by W. D. Cleghorn, Pacific Coast representative for the Mahr company. In connection with this feature, and following the reading of the paper, Mr. Cleghorn showed some very interesting photos taken recently of the huge furnaces being used to stress-relieve the welded joints of the large pipe which goes to make up the outlet pipe and penstocks at Hoover Dam. These outlet pipes are to be made of steel plate ranging up to almost 3 in. in thickness, and the diameter of the pipe will be from 25 to 30 ft.

Bennett Chappell, Jr., of the American Roller Mills, followed Mr. Cleghorn with a very interesting paper on "Frameless Steel Homes." Mr. Chappell also showed some interesting screen slides illustrating this new type of home construction. The earthquake-proof feature of this type of building construction came in for an interesting discussion, and was a timely subject, in view of the recent California "quake." Miniature samples were also shown illustrating how the sections are cut and shaped for the different uses in a building, where welding is applied. Standardized cutting of sections for the different sizes and types of dwellings, it was pointed out, makes for material reductions in production costs.

The meeting on May 18th, to be held in the Chamber of Commerce Building, will be preceded by an "old Dutch lunch" with beer. A motion picture film entitled "The Eyes of Science," will be shown through the courtesy of the Bausch & Lomb Optical Co. of California, who will be represented by George Rhode. Mr. Rhode will demonstrate a tool-maker's microscope and a polarized-light microscope. A talk on "The X-Ray in the Field of Welding," illustrated by slides and motion pictures, will be given by J. W. Capek, of the Industrial X-Ray Corp., Los Angeles. A demonstration will be given of a Metalix portable X-ray unit. This meeting will be held under the joint sponsorship of the American Welding Society and the American Society for Steel Treating.

St. Louis Electrical Group Hears Talks on Welding

"Newest Developments in Electric Welding" was the subject of an illustrated lecture given by James F. Lincoln, president, The Lincoln Electric Co., before the St. Louis Electrical Board of Trade at a meeting in the Hotel Statler held at noon on April 25th. About 93 were present to hear Mr. Lincoln describe developments that have lead to welds of very high strength and ductility, resulting in a widening of the field of application of the arc-welding process and an increase in welding speed. Mr. Lincoln also gave this lecture before 250 in attendance at a meeting of the Industrial Electrical Engineers Section of the St. Louis Electrical Board of Trade held in the plant of the Emerson Electric Manufacturing Co., 2018 Washington Ave., St. Louis, on the evening of April 25th.

Alabama Conference Postponed Till Fall

The welding conference scheduled to be held this month at the Alabama Polytechnic Institute, Auburn, Ala., has been postponed until fall, according to word received from Prof. Dan T. Jones. With continuing improvement in industrial conditions, it is anticipated that a larger attendance will be had later in the year. At least 60 days' notice will be given on the new dates.

THE cutting blowpipe, used as a tool for gouging and deseaming, has opened up a field of vast potential possibilities. This type of application is known as

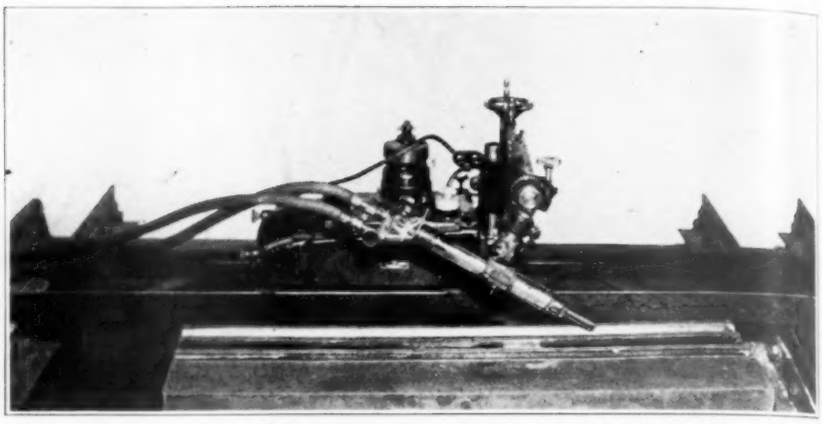


Fig. 1. Cutting Blowpipe Set Up for Gouging.

Flame Machining . . .

■ By RICHARD F. HELMKAMP
Air Reduction Sales Company

THE oxyacetylene process is always expanding. It is like mine workings in which something new is uncovered every day. For example, there is flame machining—a comparatively new development that indicates a greater outlet for the products of the oxyacetylene industry.

By the application of a different principle in the projected oxygen stream when issuing from a cutting tip, a new field has been opened up. This embraces such operations as:

(1) Rivet cutting.

(2) Deep gouging or deseaming on ingots, blooms, billets and slabs.

(3) Removing cheeks in steel castings.

(4) Deseaming cheeks in flanges of I-beams.

(5) Washing excess metal from steel castings after risers are cut to save handling and grinding expense.

(6) Scarfing of ship plates.

(7) Preparing welding grooves in steel plates.

(8) Gouging out defective welds in preparation for rewelding.

Each of the foregoing suggests the use of this process as a substitute for a machine tool for roughing out shapes. This, in a general sense, is termed flame machining.

Fig. 1 shows the machine set-up for mechanical gouging on work on which the following data applied:

Oxygen outlet of tip, ¼ in. diameter.
Oxygen pressure, 60 to 75 lb. per sq. in.
Acetylene pressure, 8 lb. per sq. in.
Length of cut, 36 in.
Number of cuts, 4.
Total length of cutting done, 144 in.
Speed of cutting, 10 lineal ft. per minute.
Angle of incidence of tip, approximately 25°.
Cubic feet of oxygen used, 33.3.
Weight of metal displaced, 8.58 lb.
Cubic inches of metal displaced, 30.19.
Cubic feet of oxygen per pound of metal displaced, 3.88.

Cubic feet of oxygen per cubic inch of metal displaced, 1.10.

Cubic feet of oxygen per lineal foot of metal displaced, 2.77.

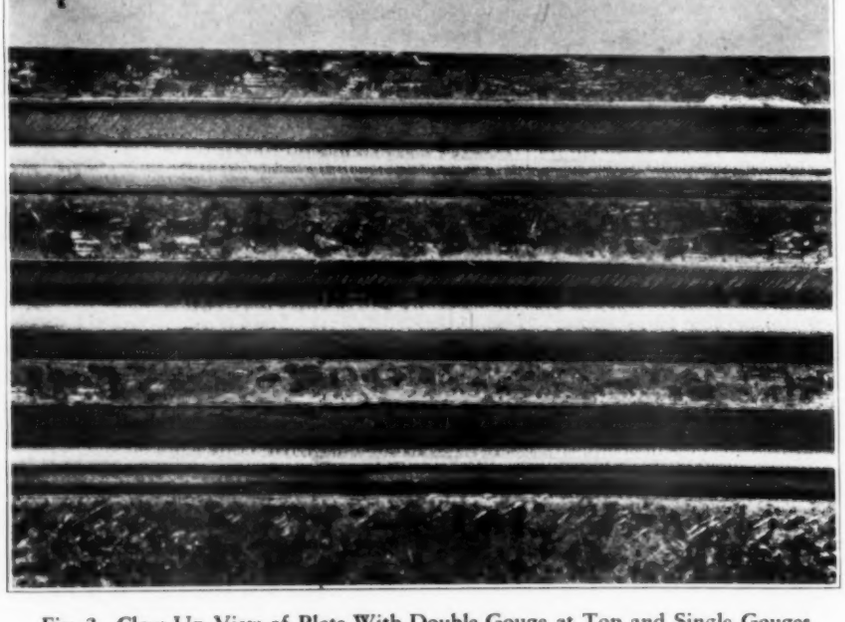


Fig. 2. Close-Up View of Plate With Double Gouge at Top and Single Gouges at Center and Bottom.

Higher Efficiency Than Obtained in Cutting Practice

It is interesting to note that the efficiency of this work, in terms of oxygen requirements per cubic inch of metal displaced, compared with the high efficiency obtained in cutting practice shows the former to be approximately 14% more efficient.

The position of the preheating flames in relation to the surface of the plate influences the contour of the gouge. Fig. 2 is a close-up view of some work accomplished with the set-up shown in Fig. 1, using a tip having six preheating holes. A double gouge is shown at the top, and a single gouge at the center. Both were made with one of the preheating flames directly in the center of the gouge. The gouge at the bottom is also a single gouge, but was made with two of the preheating flames equidistant from the center line.

The upper outer edges of the gouge were dislodged first, with the center trailing, in the first two cases.

The gouge at the bottom was made with greater preheat directed at the center and less at the sides. In this case the kerf lines are directly across the gouge, indicating that the metal in the cross-section is dislodged uniformly. Though this fig-

ure suggests a rippled surface, it is in reality very uniform and smooth, as indicated by the slight halation in the photograph.

A cross-section of the gouges is shown in Fig. 3. Inspection of the double gouge at the left shows that the second gouge, which was made without change of tip angle, speed, or pressure, is narrower and deeper than the first or initial gouge. The width of the first gouge may be seen, as well as the narrowing effect of the second gouge. It is characteristic of gouges to become narrower as depth increases.

The center gouge shows in cross-section the effect produced by positioning the preheating flames as previously described. Note that the contour is wider and of less depth than the gouge on the right. In making the gouge on the right, more heat was directed to the center and less to the upper outer edges, resulting in a deeper and slightly narrower gouge.

All gouges were made with the identical set-up of tip, angle of incidence, and speed; also identical oxygen and acetylene pressures, except when making the gouge on the extreme right, in which case the oxygen pressure was raised 15 lb. and more intense preheat was directed to the center of the gouge.

Examples of Flame Machining in a Lathe

Fig. 4 shows an example of a coarse-pitch screw, flame machined in a lathe. The cut is smooth, and uniform in cross-section.

Another example of flame machining done in a lathe is the spindle shown in Fig. 5. Here we have a number of different operations accomplished with the same torch and tip. It is interesting to note in this case that the same tool served

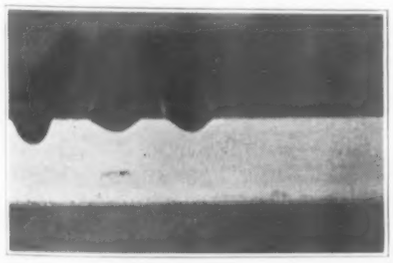


Fig. 3. End View of Gouged Plate With Double Gouge Visible at Extreme Left.

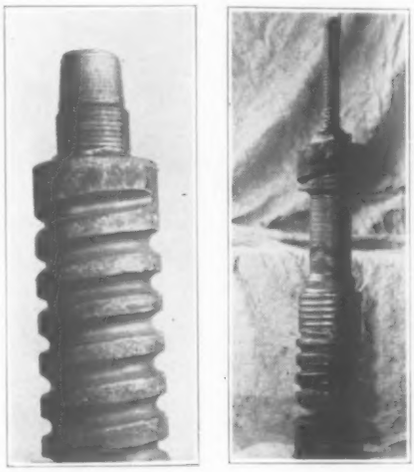
for facing, cut off, turning down and cutting screw threads at various pitches, with a negligible power consumption when considering the amount of metal removed as against machine-tool practice. The uniform cross-section indicates possibilities for roughing operations.

Preparing Plate Edges for Welding

Another adaptation of flame machining is in connection with the preparation of plate edges to form a satisfactory groove for subsequent electric welding.

In all cases, the flame-machining process leaves a bright and uniformly smooth finish. For subsequent welding or machining work, the surface is highly satisfactory.

An adaptation of the process which requires no machine equipment is the washing of excess metal from steel castings after risers have been cut off. The process is rapid and efficient and leaves a



Figs. 4 and 5. Examples of Flame Machining. Coarse-Pitch Screw Shown at Left, and Spindle at Right.

surface comparable to that of the average large casting. No special handling or positioning is needed as is the case when the grinding method is employed.

Metal may be removed at the rate of 3 to 4 lb. per minute with average equipment. Oxygen consumption per pound of metal removed averages approximately 5 cu. ft. with present practice. The operation is normally 7 to 8 times as rapid as standard grinding practice.

Purdue Students Must Take Course in Welding

All mechancial, chemical, and electrical engineering students at Purdue University, Lafayette, Ind., are required to take a course in welding, which is divided into three parts, the first covering hand work on the forge with steel tools, the second pertaining to about an equal amount each of electric and oxyacetylene welding, and the third covering steel heat-treating. Prof. J. D. Hoffman states that some day this course will probably be required of civil engineering students, but conditions have not yet allowed it to be worked into the civil engineering curriculum.

In addition to the above course on welding, there are two superimposed courses that are elective—that is, the student can take either of them or not, as he chooses. Each of these two elective courses covers a full year. One is devoted to welding and the other to heat-treating.

Special Welding Meeting for Engineers' Week

A meeting on welding will be held under the auspices of the Chicago Section, American Welding Society, in Chicago on Thursday, June 29th, of Engineers' Week, which is being observed in connection with the World's Fair (A Century of Progress), which opens on May 27th. This meeting will be held in the Gold Room at the Congress Hotel, which has been designated as headquarters by the Chicago Section, and will comprise two or three papers dealing with those aspects of welding that will attract those engineers visiting the World's Fair during Engineers' Week. One of these papers will discuss welding as used in the construction of the "Sky Ride," the dominating structural feature at the Fair, and will be given by A. L. Wilson, of the Mississippi Valley Structural Steel Co., fabricators of these towers. These papers are scheduled for the period between 10 and 11:30 a. m., and will be followed by a luncheon with a round-table discussion. Every opportunity will be given visiting engineers and local men to present their welding problems for discussion, and later in the day the group will be invited to visit the Fair grounds and inspect those constructions that have an especial appeal to them.

Class in Oxyacetylene Welding in Purdue University Forge Shop.

Charging Carbon-Dioxide Gas Into a Gasoline Truck-Tank While Welding on a Patch Near the Tank Bottom.

Removing the Hazards in Welding Tanks containing inflammable vapors

■ By W. E. ARCHER

WITH the development and wide use of oxyacetylene and electric welding in the various departments of the petroleum industry, many accidents have resulted from explosions caused by heating hydrocarbon gases in the vessels to be welded. It is also a fact that the spark from a hammer can cause an explosion which may result in a serious fire or wreck a plant. When equipment of this kind is in need of repair, unless it is thoroughly and properly steamed or otherwise cleaned, this hazard is an ever-present menace. Executives and engineers in charge of the maintenance of this equipment appreciate the expense incurred in getting these vessels in condition to weld or otherwise repair. A new use for carbon dioxide will largely eliminate this hazard in the future, as has been recently demonstrated.

The Carbonic Products Company, Inc., of Tulsa, Okla., manufacturers of liquid and solid carbon dioxide (often referred to by its chemical term CO_2) recently started a number of tests to determine a safer and more economical way to do this work.

Carbon dioxide as it vaporizes becomes a heavy gas—much heavier than the more volatile hydrocarbons or air. Having a specific gravity of 1.52, it has a tendency to settle to the bottom of a vessel in which it is released. It is this property of carbon dioxide that makes it especially applicable to this process, because it is non-inflammable, and if mixed in the proper proportion with hydrocarbon gases a non-explosive mixture results.

For most uses, such as repairing empty vessels, it is said that a 20% application of carbon dioxide will create a non-explosive mixture. However, from the standpoint of safety, it was determined after many tests to be most practicable to use about 40% carbon dioxide in mixtures in vessels to be welded. It was demonstrated that a tank containing 40% of carbon dioxide in the void space above the liquid could not be exploded even when natural gasoline was contained in the tank.

Tests Show That Welding Can Be Done With Safety

These tests were conducted by charging a compartment of a gasoline truck-tank and other vessels with carbon dioxide from a cylinder until the gas mixture would not ignite at the opening on top of the tank or vessel, and then proceeding to weld the patches or otherwise repair in the usual way. Both the oxyacetylene torch and the electric arc were employed in these tests without trouble. The accompanying photograph shows a cylinder of carbon dioxide charging a compartment of a gasoline truck-tank while an electric welder is applying the arc to a welded patch on the bottom of the tank.

In a more severe test, three gallons of natural gasoline were poured into an oil drum, after which the drum was rolled around to distribute the fluid thoroughly over the sides and ends. The drum was then set on end and enough carbon dioxide gas was put into it to bring the percentage of this gas escaping at the hole in the top of the barrel to 40%. A hole was then burned into the drum with the welding torch without an explosion occurring. It is good policy from the standpoint of safety to have a small amount of carbon dioxide turned into the drum during the welding operation to compensate for the escaping gas and prevent the percentage from dropping below the danger point.

These tests indicate that it is now practicable to weld on a tank without the expense and trouble of steaming and cleaning (not to mention the loss in production of oil in many cases) by merely injecting into the tank enough carbon dioxide to bring the gases in the tank to a composition of 40% of carbon dioxide, which gives an ample allowance beyond the danger point. In this connection, by referring to bulletin R-13172, Department of Commerce, entitled "Report of Investigation on Inflammability of Mixed Gases," by G. W. Jones and R. E. Kennedy, it will be seen that no explosion is possible after the carbon-dioxide concentration passes 28%. To determine the percentages of carbon-dioxide gas and hydrocarbon gases in a mixture, a Hayes analyzer is used, the same as in a test for the presence of oxygen in a gas.

Much interest has been shown in this safety process, and especially by petroleum engineers, oil-field welders, and those interested in tank welding. One large company is also considering the use of carbon dioxide for fire protection on their oil storage tanks. Since carbon dioxide does not deteriorate with age, and does not freeze and can be stored safely at any and all atmospheric temperatures, it is felt that a great saving can be made by its use for this purpose. Carbon dioxide is obtainable in all trade centers, as it is in use very generally in all bottling plants and soda fountains.

Method Can Be Applied to Welding of Pipelines

Pipeline welding will also benefit by the use of carbon-dioxide gas. Where there is need for welding leaky gate valves on pipe lines, it is possible to tap the line and admit carbon-dioxide gas to produce an inert mixture in the valve so that welding can be done safely. Similar methods can be applied to various vessels to be welded along the pipe lines, in the refinery, and in the field. This method is particularly valuable when applied to apparatus to be welded that would otherwise have to be moved from its position at a considerable cost, and in some instances would involve the closing down of other units of a plant to permit the movement of the part to be welded.

The tests herein described, and others, were under the supervision of H. Ross Campbell, superintendent of the Tulsa, Okla., plant of the Carbonic Products Co. Ben Beaty, of the C. C. Forrester Welding Co., and C. C. Reeves, of the Air Reduction Sales Co., were present and gave valuable and appreciated assistance during much of the test work.

Death of Lee Miller, Steel Executive

Lee H. Miller, chief engineer and organizer of the American Institute of Steel Construction, Inc., passed away at St. Luke's hospital in Cleveland, Ohio, on April 9th. Born in 1877, the son of a Canadian farmer, Mr. Miller was educated in Canadian schools and was graduated from the school of engineering of Toronto University in 1900, following which he worked for various steel companies and machinery manufacturers in the United States, first as structural-steel draftsman and later as estimator, designer and salesman. In 1922 he started the work of organizing the American Institute of Steel Construction and was actively associated with the development of the Institute until his death. He took an active part in many of the programs of the American Welding Society.

All-Welded Oil Barge Crosses Atlantic

The all-welded oil barge *Peter G. Campbell* sailed from England on April 20th with the tug *Ajax*, and was scheduled to arrive in Toronto about May 11th. This vessel is 179 ft. by 35 ft. by 15 ft. and has a total capacity of 1700 tons. It was built by Messrs. Swan Hunter & Wigham Richardson, Ltd., of Wallsend-on-Tyne.

American Welding Society Holds 14th Annual Meeting

OUTSTANDING features of the fourteenth annual meeting of the American Welding Society, held on April 27th and 28th, at the Governor Clinton Hotel, New York City, included the substantial approval of the new A.W.S. welding wire specifications; the presentation of tentative specifications covering use of fusion welding and oxy-acetylene cutting of steel parts for machinery construction, by G. D. Spackman, committee chairman; report of pressure piping code committee, and noteworthy lectures on "Erecting Steel Buildings and Strengthening Steel Bridges by Welding," delivered by Prof. F. P. McKibben, president of the society, and "Welding, a Factor in Industrial Revival," by Willard T. Chevalier, as well as other interesting lectures.

Keen interest was manifested in the new welding wire specifications, which replace the former specifications based on chemical analysis; the new specifications, which were prepared by a committee under the chairmanship of Charles A. McCune, have received approval and will probably be available in printed form about June 15th. The work of the committee, as reflected in the new specifications, the need of which had long been realized, has received widspread commendation.

A well-received innovation was the introduction to the program of several interesting non-technical addresses. "Must Industry Be a Pawn or a Power," by Charles F. Abbott, executive director, American Institute of Steel Construction, and "Welding, a Factor in Industrial Revival," by Willard T. Chevalier, publishing director, "Engineering News-Record and Construction Methods," were presented at the Friday morning session. Mr. Chevalier's address which portrayed an inspiring picture of the part the welding processes play in industrial rehabilitation and progress, was one of the high-lights of the meeting.

The Samuel Wylie Miller Memorial Medal was awarded to H. H. Moss, Linde Air Products Co., for his work in the advancement of fusion welding and flame cutting.

The outstanding address of the session was Professor McKibben's presentation covering the erection of steel buildings and the strengthening of steel bridges by welding, which was accompanied by many illustrative views, charts and other tabular material. The steady growth in number of municipalities permitting the use of welding in the erection of steel structures was shown. In the course of his lecture Professor McKibben voiced the opinion that disproportionately great emphasis had been placed upon the necessity for tests in connection with structural welding. The over-stressing of necessity of tests, it was pointed out, results in the questioning in the minds of some of the safety of the welding processes. Fear results from inexperience and ignorance, and it has been shown that welding is as safe as the other processes of the industrial arts.

At the election of officers, Prof. Frank F. McKibben, consulting engineer, and a foremost authority on arc welding of structural steel, was renamed president of the society; J. J. Crowe, engineer in charge of apparatus research and development, Air Reduction Sales Co., was elected senior vice-president; Charles A. McCune, consulting engineer, was renamed treasurer, and Miss M. M. Kelly, secretary. G. Raymond, American Tank & Equipment Co., Oklahoma City, Okla., and D. J. Williams, Air Reduction Co., San Francisco, were elected vice-presidents for the Southern and Pacific Coast divisions, respectively.

The newly elected directors are: A. Vogel, General Electric Co.; W. H. Gibb, Thomson-Gibb Electric Welding Co.; H. S. Smith, Prest-O-Lite Co.; W. C. Swift, American Brass Co.; and J. C. Lincoln, Lincoln Electric Co.

At the meeting of the American Bureau of Welding, held Friday afternoon, with Dr. Comfort A. Adams presiding, reports of committees, and progress reports of university workers associated with the Fundamental Research Committee, were presented. All officers were reelected as follows: Dr. C. A. Adams, professor of engineering, Harvard Engineering School, director; H. M. Hobart, consulting engineer, General Electric Co., and J. H. Crickett, head of research, Union Carbide & Carbon Corp., vice-directors, and W. Spraragen, secretary.

Shielded-Arc Welding in Railroad Shops—I

First of Two Articles

■ By W. B. HORTON
The Lincoln Electric Company

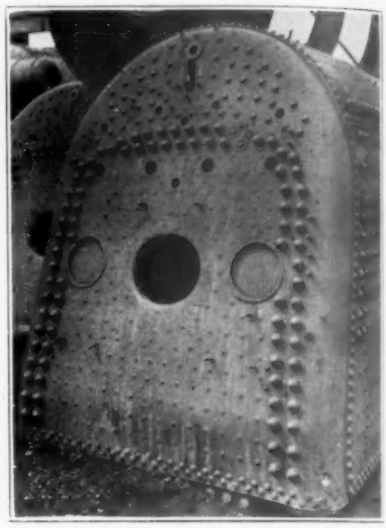
ARC-WELDING equipment can be used in the repair and reconstruction of practically any ferrous-metal unit. No item of railroad welding is of more importance than boiler welding. This work is of such a nature that it lends itself readily to the welding process, and the economies are so large that practically all railroads use this method of repairing fireboxes and smokeboxes. In the railroad tank shop, arc welding is imperative.

There are, however, vast differences in standard practice on the various roads as to the method of welding used. It may be of interest to note here that some railroad boiler shops operate their welding satisfactorily at a cost only half of that of others; and when these costs are extended to an entire system, it is readily seen that a tremendous saving is made.

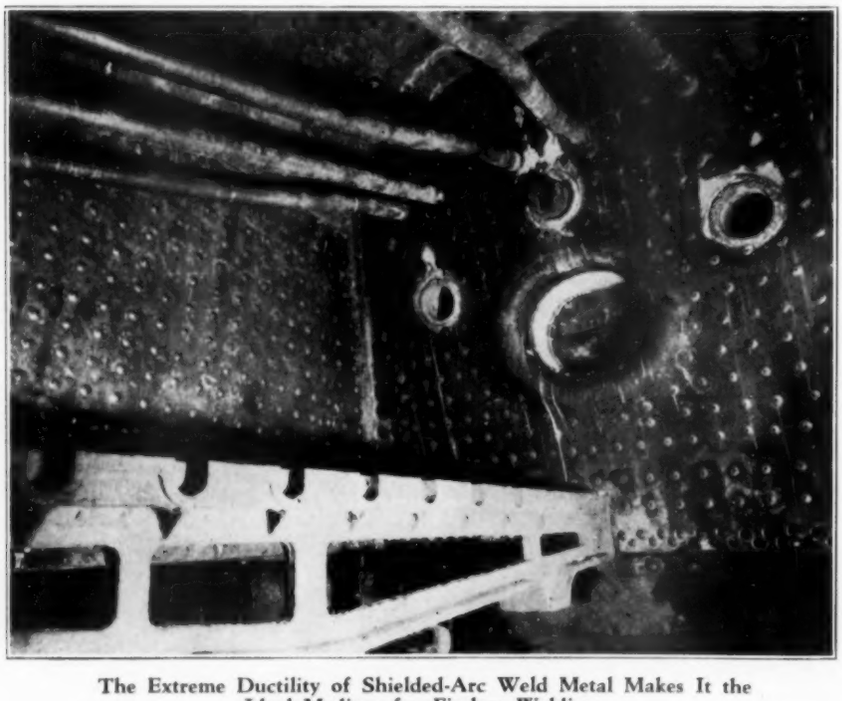
Making Repairs on Locomotive Boilers

For the purposes of this article, we shall class as boiler welding all welding done on locomotive boiler fireboxes and smokeboxes and their component parts. We will list some of the representative applications, and the method of procedure with the shielded arc. In general, the only difference in arc welding with the latter as compared with standard electrodes is that a somewhat longer arc is held, the plates are fitted more closely together, higher across-the-arc voltage is used, and the operator must move more quickly. It is also important, with the heavily coated electrode, that each layer of weld metal be cleaned and peened, although, as a matter of fact, this procedure improves any electric arc weld. We will now examine some of the major boiler welding applications with the shielded arc.

Firebox Sheets: Edges of both old and new sheets should be clean and beveled at an angle of 30° each, or a total of 60°. On the upper seam, the new sheet should be bolted so that a gap of approximately ⅛ in. is left. The same is true of the vertical seams. The lower seam can be nearly tight, as the contraction resulting from the other welding will open it somewhat. The first seam is tack welded about every 12 in., after which the bolts may be knocked out. One should use 5/32-in. or 3/16-in. electrodes, and about 30% more current than with equivalent sizes of bare electrodes. The first bead is laid directly in the center of the seam with a slightly weaving motion, and is laid longitudinally. In other words, it is not attempted to fill the entire gap with the first bead. About a 12-in. length of bead is laid, then a like distance skipped, proceeding across the entire width, then returning and filling in the skipped sections. After welding the first 12-in. section, the operator should stop and examine the weld with a flashlight from the water side. The weld should be clean and flush with the sheets, and with no gaps or "mud catchers." Adjustment of the welding current should be made until correct penetration is secured. Vertical seams are applied in approximately the same manner, working down from the top.



This Firebox, Now in the Scrap Heap, Had Its Life Materially Lengthened by Arc Welding.

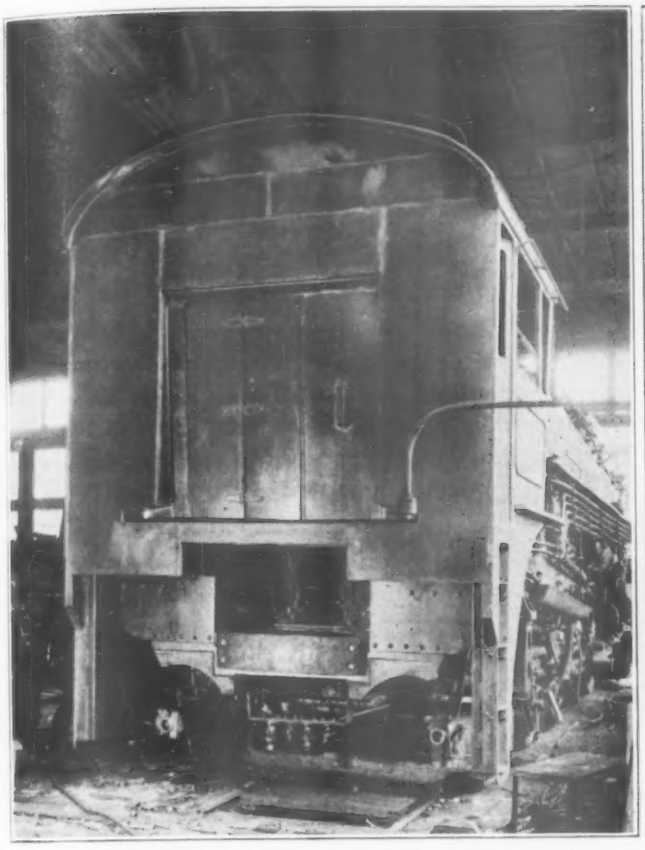


The Extreme Ductility of Shielded-Arc Weld Metal Makes It the Ideal Medium for Firebox Welding.

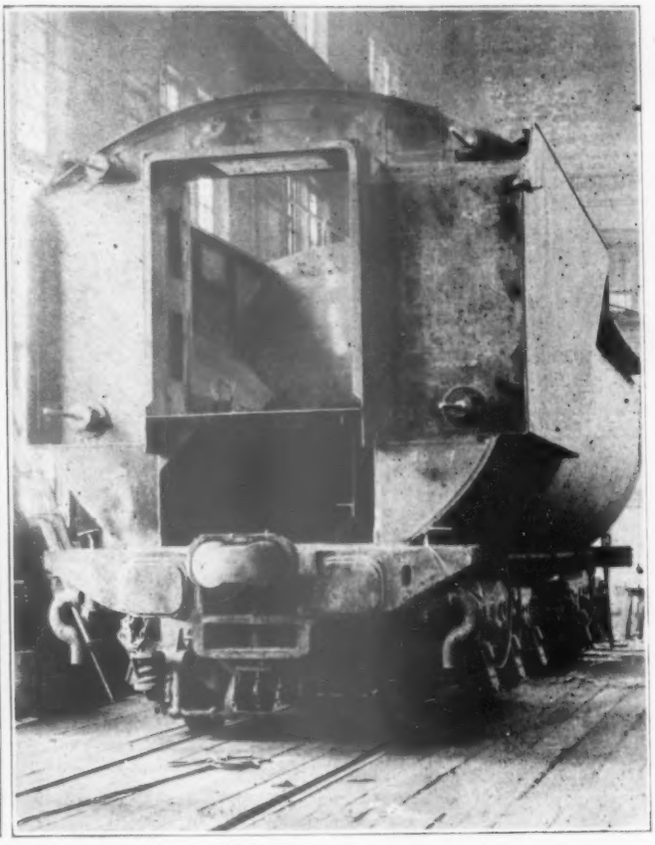
Patches: Patches should be cut oval shaped and welded in the same manner as prescribed for side sheets. Where a small hole is to be filled up, it is best to cut out a stamping a little smaller in diameter than the hole, flush the stamping off even on the water side, then weld it flush on the fire side.

Mud Rings: Mud rings, when worn, are built up flush again with successive beads of 5/32-in. electrode. When cracked, they are welded with ¼-in. electrodes from the top side. When mud-ring vents are worn thin, the sides of the hole may be built up by rings of beads around the hole. The hole may then be reamed and re-tapped without difficulty or damage to the tools, owing to the fine, soft quality of the weld metal. This will be of interest to the machinist who has been having difficulty because of breaking tools on the "hard-spot" metal deposited by the ordinary electrode.

Flues: Welding of flues requires the most conscientious preparation and most careful work of all boiler welding. The flues are applied and set just as they would be if not welded, except that coppers should be set back 1/16 in. from the



Cab of Crack Transcontinental Flyer Built by Arc Welding in Shop of Large Railroad Company. This Cab Is Stronger and Lighter Than One of Riveted Construction.



This Tank Was Constructed by Shielded-Arc Welding. The Shell Was Welded Directly Into the Water Bottom of the Tank.

fire-side edge of the hole. The flue sheet should be absolutely clean and free of oil, scale, etc. on the fire side. Electrodes 1/8 or 5/32 in. in size are used. Good penetration and sound, smooth welds insure a successful and durable repair.

Flues Need Not Be Burned Out Before Welding

With shielded-arc welding, it is not necessary that the flues first be run unwelded to be burned out, as the lack of porosity in these welds prevents any attack from the water side with resultant cracks.

Flues should not be welded in consecutive order, and the operator should work on a different part of the sheet for each flue. This practice avoids localization of the heat and consequent stresses. Time saved on flues should be 200% to 300%.

Crown Sheets: Any defective section in cracked crown sheets should be cut out and a welded patch put in. If too large a section is defective, however, it is best to replace the sheet, in which case, the general procedure is the same as for firebox side sheets, though in some cases the weld becomes an overhead fillet weld and the sheets should be closely fitted. Time saving on crown sheet welding is close to 50%.

Door Sheets and Flue Sheets: Door-sheet and flue-sheet welding follow the same procedure as side-sheet welding.

Thermic Syphons: This is a very important application of the shielded-arc process, because high ductility of the weld metal is necessary to withstand the extraordinary strains to which these members are subjected.

Application of Process to Tank Work

An important application in railroad tank welding is the building up to flush of coal holes in the tank floor. On such jobs 1/4-in. or 5/16-in. heavily coated electrodes may be used.

There are also a great many minor jobs in the tank shop that are applicable to welding, such as the fastening on of broken off or newly added steps, handles, ladders, bars, etc. It is much cheaper to handle such jobs by welding than by riveting or bolting; and once correctly welded in place, they are there to stay, with no separate parts to work loose.

It is very probable that the time is drawing near when practically all new tanks will be of all-welded construction. It is a cheaper method than riveting, and a saving of weight with no loss of strength may be secured. The fabricating problem does not materially differ from

This All-Steel Freight Car Is Perfectly Adapted for Fabrication and Repair by Welding.

that of tank construction in other industries where welding has become almost universally adopted; and a very large percentage of this welding is accomplished with the shielded arc, either automatically or manually applied.

The use of welding on tanks is dictated by the fact that engineers who utilize the latest welding methods now consider a welded tank as a seamless one-piece structure. Arc welding insures a leakproof joint which will not corrode at the rivet heads or at the seams.

The use of welding in the fabrication of freight containers provides large economies as compared with riveting. In addition, containers of welded design are lighter than riveted containers of equal capacity. Because of its homogeneity, the welded container withstands better the strains of frequent lifting and moving, and remains weatherproof. Either the automatic or manual type of welding in a protected atmosphere may be used in the manufacture of containers. Where there is a fairly large number of units going through in one lot, the automatic process will prove economical. Where it is customary to build them in small lots during spare time in the shop, the manual process is preferable.

Welded Steel Cars Reduce Dead Weight

Manufacturers of steel cars, as well as railroads that build their own, have been experimenting with all-welded construction for a considerable period. In fact, such fabrication has now passed the experimental stage. One railroad has had ten welded cars in service for over a year. The weight of the welded cars is considerably less than riveted ones of like capacity. This saving of weight is of course of the utmost importance. It means that six empties can be hauled by the same power previously required for five. It means just so many fewer pounds of "dead" weight.

Steel cars of any type can be economically fabricated by shielded-arc welding, using either the automatic or manual process. Where only a few cars are constructed at a time, it is more economical to use the manual process. If a fairly large number can be planned through in a lot, automatic welding will be cheaper.

With the gradual advent of the all-steel box type of freight car, together with the large number of steel gondola and hopper cars in service, welding has assumed larger and larger proportions as a method of repair in car shops. The ease, adaptability and low cost of welding as compared with other repair processes have made welding equipment of the highest importance as shop tools.

An important item in car welding is that of reinforcing bars or straps on the body or understructure. The latter has members that are subjected to extreme torsional strains, and these members can be supported sufficiently by welding so the car gives long and reliable service.

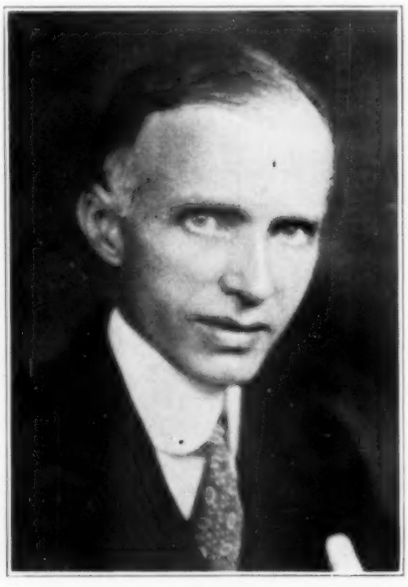
Building Up Equalizer Ends Results in Savings

Another job that is very important is the building up of equalizer ends. Here the nature of the work is such that large-size heavily coated electrodes (5/16 or 3/8 in.) may be used. One railroad accomplishes savings of $12.50 on the direct cost of welding each set of eight equalizers, through the adoption of shielded-arc technique for building up the ends. After welding is completed, this railroad heats the built-up ends and smooths them with the hammer; welds so made can be hot worked, which is not true of ordinary electric-arc welds.

There are other build-up jobs on car parts, and on all of them the same proportional savings are made.

Welding Industry Mourns Passing of J. B. Green

The death of J. B. Green, founder and president of the Chicago Steel & Wire Co. and the Fusion Welding Corp., on April 24th, marked the passing of a man



J. B. GREEN

whose brilliant intellect, capacity for service, and resourcefulness has made for him a host of friends in the welding industry. Mr. Green's death occurred at St. Luke's hospital, where on the advice of his physician, he was a patient for several weeks and had undergone two operations.

Mr. Green was born in Chicago 47 years ago. He was educated as a mechanical engineer at Cornell University, where he was graduated in 1910. He was a man of wide interests and held memberships in several engineering societies and social clubs. He took an active interest in the work of the American Welding Society and was a member of the Committee on Filler Metal Specifications. Just three days prior to his death he was nominated for the office of chairman of the Chicago Section of the Society, and had served as vice-chairman during the year just drawing to a close.

Welding Conference Held in Seattle

A conference on "Welding Technology" was held in Seattle, Wash., by the shop division of the mechanical engineering department of the University of Washington, on the afternoon and evening of May 11th, with the technical sessions held in Guggenheim Hall at the University.

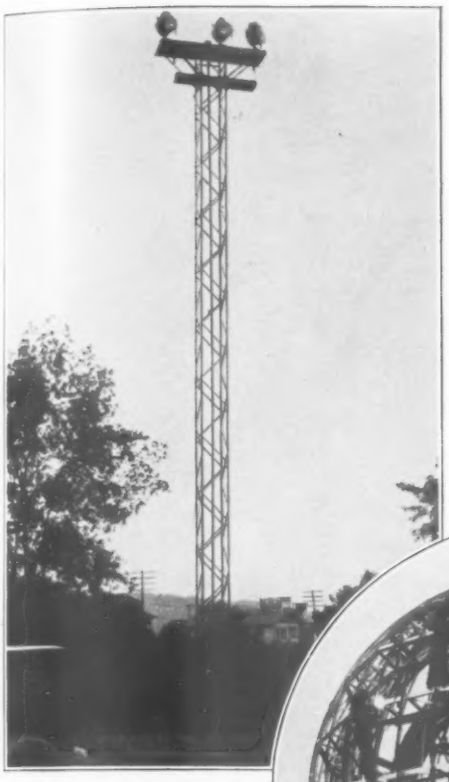
The following papers were read: "The Application of Electric Welding to Ship Construction," by Geo. A. Holderness, Jr., U. S. Navy; "A New Process for Making Welded Joints in Steel," by L. F. McKenzie, Linde Air Products Co.; and "Welding of Heavy Pressure Vessels," by O. E. Andrus, L. J. Larson, and T. McLean Jasper, all of the A. O. Smith Corp. (paper read by Prof. B. T. McMinn of the University of Washington). Following the discussions on these papers, a film was shown on "Oxyacetylene Welding" by The Linde Air Products Co., and a sound film entitled "The Hottest Flame in the World," dealing with atomic-hydrogen welding, by J. E. Haseltine & Co. and the General Electric Co.

At an informal dinner held at the University Commons in the evening, at which Prof. Gilbert S. Schaller was toastmaster, addresses were given by R. G. Tyler, dean of the College of Technology at the University, and G. W. DeSellem, of the Westinghouse Electric & Manufacturing Co., followed by an address on "History of the Iron and Steel Industry in the Pacific Northwest," by Joseph Daniels, professor of mining and metallurgy.

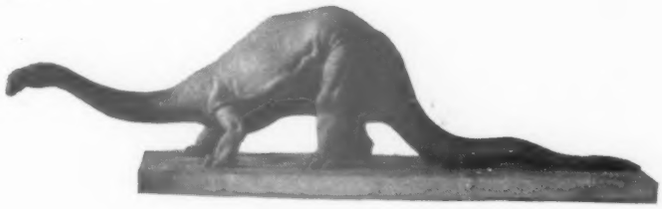
At a later technical session held in Guggenheim Hall, A. G. Bissell, consulting engineer, gave a very interesting illustrated lecture on "Arc Welding Opportunities in and About Seattle" and F. R. Belcher, Air Reduction Sales Co., closed the session with a paper on "Theory and Practice of Oxyacetylene Cutting."

In addition to the technical papers, welding exhibits and demonstrations were given by the Air Reduction Sales Co., General Electric Co., J. E. Haseltine & Co., Linde Air Products Co., and Westinghouse Electric & Manufacturing Co. Demonstrations were also given of hardness measurements for Brinnell and Rockwell readings and by the scleroscope method, and Prof. B. T. McMinn demonstrated the principles of microscopic examination of cast iron and steel.

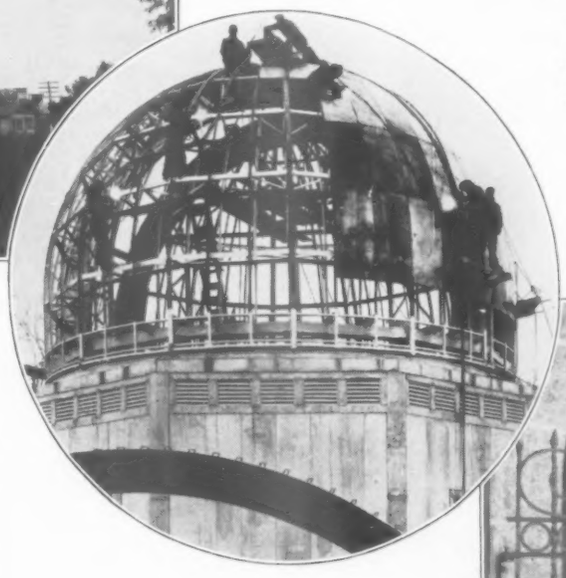
WELDING NEWS IN PICTURES . . .



The all-welded floodlighting tower has many advantages over riveted towers, says Joseph H. Hively, of Newberry, Pa., who designed the one shown.



A life-size brontosaurus, 70 ft. long, is being constructed with welded framing from the clay model shown above. This huge life-like animal will be part of the Sinclair Refining Co. exhibit at the Chicago World's Fair.



This welded dome, under construction, will house a huge telescope in Washington, D.C. This is one of two all-arc-welded observatories being built in Washington, D. C., by the J. K. Welding Co., using equipment manufactured by The Lincoln Electric Co. By eliminating riveting, there is no likelihood of damaging the delicately balanced Naval Observatory clock, which is less than 90 yards away.

Ornamental iron gate made by C. A. Sandborg & Son, Bloomington, Ill. All parts made from standard bar stock, formed and brazed.

All-welded 120,000-gallon oil barge, 145 ft. long, built by the Chicago Bridge & Iron Works for the Pure Oil Co., and launched at Savannah, Ga.

Fig. 1. Arc Welding a Main Delivering Gas at 75 Lb. Pressure to a Steam Power Station.

Power-Plant Pipe Welding

■ By J. A. BLECKI and F. J. SCHLACHTER
The Detroit Edison Company

THE first application of pipe welding by The Detroit Edison Co. was in 1924, when the screwed forged flanges on a 16-in. feed pump line were back-welded. It is now the practice of our company to back-weld all screwed flanges on vacuum, bleeder-steam and exhaust lines and on all other systems where extreme tightness is desirable. For this work bare wire is used, because it seems to result in less warpage.

In the same year the 24-in. circulating-water suction and discharge piping was welded on three condensers at the Trenton Channel power plant. A bell-and-spigot joint was used with fillet welds.

In 1926 welding was attempted on a small scale at the Beacon St. heating plant; 6-in. tee branches were welded into a 28-in. low-pressure exhaust header, thus avoiding the purchase of two expensive tees. At the Connors Creek power plant a 42-in.-diameter cast-iron circulating-pump suction was replaced by a longer suction made in the shop in sections from ⅜-in. steel plates and butt-welded in the field. Later in the same year a 6-in. atmospheric exhaust line from a turbine-driven pump was welded in the field.

DURING the past eight years The Detroit Edison Co. have gradually extended the application of welding to piping throughout many of their departments. This paper, presented before the Highway Congress held at Detroit, Mich., January 18, 1933, outlines the progress made by this company in pipe welding.

By 1927 it had become quite common practice with our company to fabricate special pipe fittings by welding, and numerous tee and wye branch connections in large headers were made by this method, but the use of welding was restricted to pressures below 125 lb. and relatively low temperatures (400° F.).

During 1928 and 1929 the amount of pipe welding was considerably increased, but no further advance was made in welding higher-pressure lines. A few of the outstanding installations follow:

WILLIS HEATING PLANT:
- 12-in. safety-valve vent header with 6-in. branches.
- 10-in. and 6-in. storage-tank piping.
- Soot-blower steam header (125 lb. pressure).
- 12-in. and 14-in. low-pressure turbine exhauster.
- Drain piping.

DELRAY POWER HOUSE No. 3:
- 12-in. heating header and branches (8 lb. pressure).

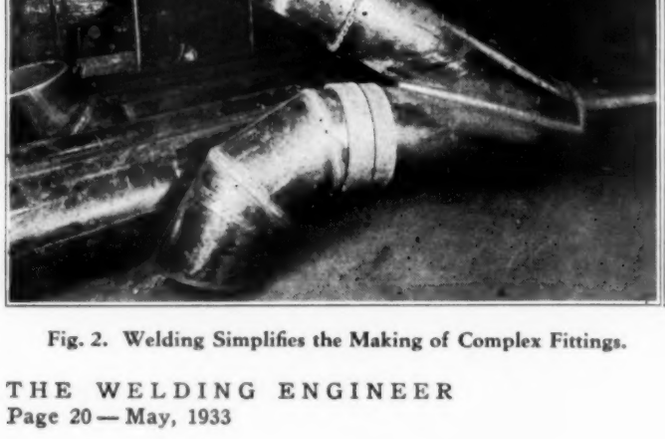


Fig. 2. Welding Simplifies the Making of Complex Fittings.

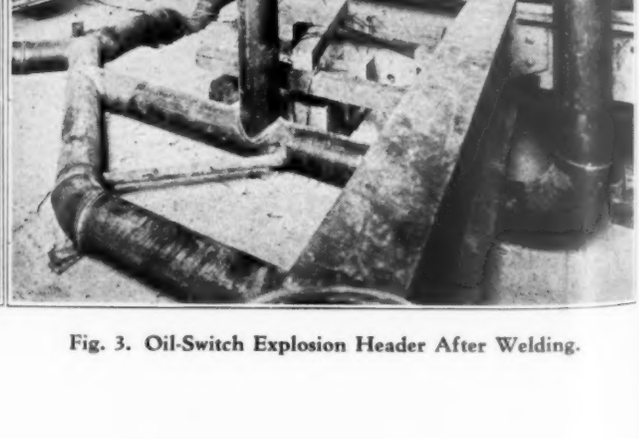


Fig. 3. Oil-Switch Explosion Header After Welding.

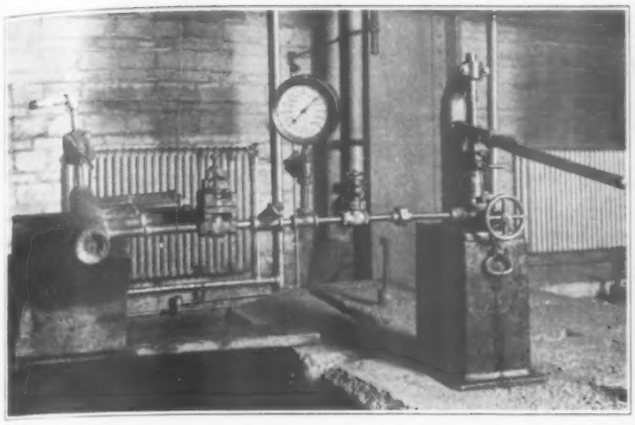


Fig. 4. Applying 4000-Lb. Test to Welded Manifold.

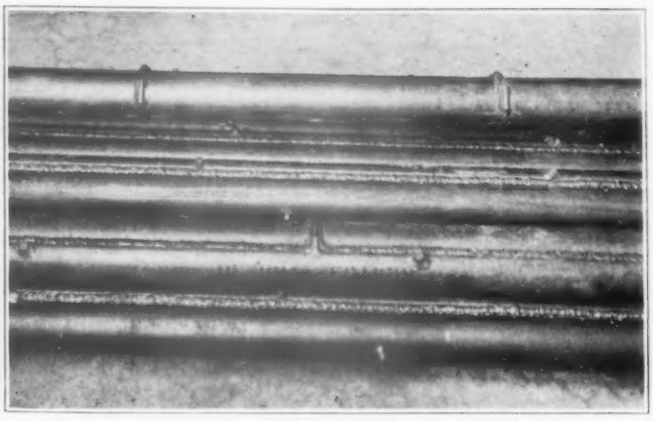


Fig. 5. Soot-Blower Tubes and Elements for Power Boiler.

10-in. bleeder piping from auxiliary turbines to heating header (8 lb. pressure).
6-in. and 4-in. compressed-air lines (100 lb. pressure).
18-in. atmospheric exhaust from auxiliary machines.
10-in. atmospheric exhaust from boiler feed and general sewer water pumps.
6-in. vents and exhausts from heaters and vacuum pumps to canal.
Back-welding all lines under vacuum.
24-in. circulating-water piping to and from condensers (15 lb. pressure).
4-in. and 3-in. piping in heating returns to pit (8 lb pressure)
6-in soot-removal lines.

MARYSVILLE POWER PLANT:

48-in. and 16-in. circulating-water piping to condensers.
14-in. atmospheric exhaust from auxiliary turbine.
6-in. atmospheric exhaust from water pump.
12-in. and 14-in. hotwells on stage heaters.
6-in., 8-in. and 12-in. pipe connections in meter-house gas line.
6-in. and 8-in. gas line from meter-house to distribution system.
6-in., 8-in. and 12-in. suction and discharge lines from compressors.
(These gas lines operated at 350° F. and 75 lb. pressure.)

ALGONAC, NEW BALTIMORE AND ROMEO:

All compressor piping, control piping and lines to and from holders (diameters, from 2½ to 6 in., and operating pressure, 75 lb.). One of these lines is shown in Fig. 1.

During 1930 there were very few new types of welded construction erected. The 8-in. oil-switch explosion header at the Howard substation and the 12-in. and 28-in.-diameter turbine exhaust piping at the Congress and Beacon heating plants were the more important of these.

High-Temperature Steam Line of Stainless Steel

The year 1931 showed considerable progress, however, in several new installations. The most notable of these was the line carrying superheated steam at 400 lb. pressure and 1000° F. I.P.S. stainless-steel (KA2S) tubing, 8 in. in diameter, was used in the line and position welded by electric arc using 5/32-in. (KA2S) coated electrodes. The finished weld consisted of fourteen layers or beads of weld metal, each bead being cleaned thoroughly with a chipping chisel and wire brush. A preliminary test weld made with the same materials gave tensile strengths ranging from 65,000 to 75,000 lb. per sq. in. The line weld was mechanically reinforced by flanges with screwed collars and twelve 1½-in.-diameter bolts.

A 100-lb. circulating-water line at the Delray research laboratory was connected with welded piping.

At the Congress heating plant an old 16-in.-diameter spiral riveted exhaust line running from the bottom of the heating tunnel shaft to the roof, was replaced by a pipe with ¼-in. wall, all field welded. There were 36 butt welds in this job, including some very difficult elbows and fittings, as illustrated in Fig. 2. All burning and fitting was done in the field, and coated electrodes were used throughout for the welding.

A zeolite system of water purification was also installed at this plant with all piping field welded. This job included 238 welds of 4, 6 and 8 in. diameters, to be operated under various pressures up to 100 lb. per sq. in.

Hammer Test Given Welded and Screwed Joints

At the Connors Creek power plant, a 4-in., 100-lb. general service line with many hose connections was fabricated in the field by welding, also all the safety-valve-vent extensions were connected to old vents by welding when the roof of the power house was raised. When applying the hydrostatic test to this general service line, the hose connections were blanked off with screwed caps, and it is worthy of note that the only difficulty experienced was in keeping these screwed caps tight. The welds withstood the hammer test 100%, but every one of the screwed connections leaked badly when the welds were hammered.

At the Madison substation a 6 in. oil switch explosion header was erected. Fig. 3 shows a view of this header.

During the year 1932 construction projects were rather scarce; however, one or two interesting welding jobs were completed.

Welding a High-Pressure Carbon-Dioxide Line

At the Ann Arbor office building air-conditioning equipment was installed, which included 58 welds on ¾-in. and 1¼-in. piping. This line was designed to sustain a carbon-dioxide pressure of 1000 lb., and welding was specified because it took up less space and represented a saving over a threaded job. Test pressures exceeding this, with welds soaped, failed to reveal any leaks, and after six months service the welds are still tight. Bare-wire electrodes were used on this job because they were easier to handle on the small sizes of pipe.

Before starting this job, a test specimen was made by the welder who was to do the field welding. This specimen consisted of a 3-in. extra-heavy Bessemer-steel-pipe welded manifold with four 1¼-in. and two ¾-in. welded branches as illustrated in Fig. 4. Half of this specimen was welded with bare electrodes

Fig. 6. Welded Piping for Steam Flue-Blower Units Under 1000-Lb. Pressure Test.

and half with coated electrodes, and it stood the test of 4000 lb. per sq. in. without failure.

At the Trenton Channel power plant the auxiliary steam lines to the Diamond soot blowers were erected with 2-in. seamless steel tubing, having a carbon content of 0.35%. Coated electrodes were used on this job, requiring the fabrication by welding of 27 tee branch connections, 9 of which were position welds. This line

Fig. 7. Its Compactness and Portability Make Oxyacetylene Equipment Preferred for Underground Work.

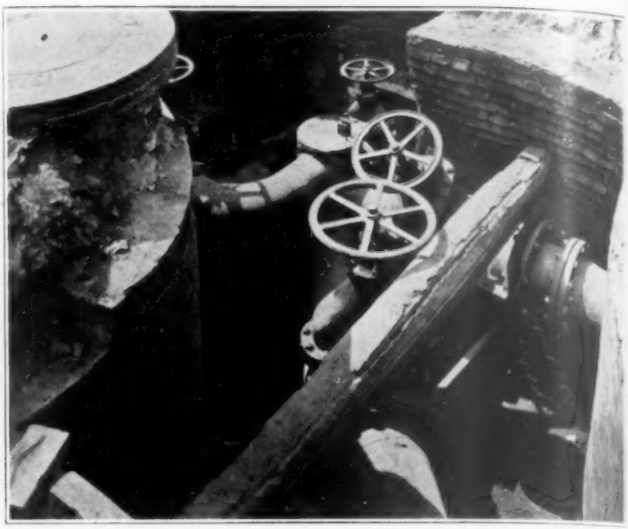


Fig. 8. View in Manhole, Showing Welded Pipe Joints and Fittings Welded Into Lines.

has since been operated under 200 lb. pressure and 360° F. temperature without any leaks. Welding produced a very neat job, as may be seen from Fig. 6, which shows one of the sections ready for erection.

A 2200-ft., 10-in. pipe line was installed from a refinery to the Trenton Channel power plant. This line was welded by a contractor, except within the limits of our own property. On this latter section our men made a total of 66 10-in. circumferential butt-welds, outside the building, which developed only one leak under test. The faulty weld was removed and the joint rewelded. Twenty-two of these were position welds. Inside the building, a total of 91 welds were made on pipe ranging from 2 to 12 in. in diameter, 27 of which were position welds. Coated electrodes were used on the company end of this job.

Fit and Weld on the Floor Wherever Possible

It is important both in the interest of quality and economy that the piping be designed so that as much fitting and welding as possible can be done on the floor, keeping the position welds to the minimum. Careful attention to this detail will also permit the fitters to prepare a large number of joints before calling for the welder.

In our company the fitters and welders operate under different divisions of the Construction Bureau, and it is only within the past two years that the functions of these two groups have been properly coordinated. Now, the fitters are not waiting for the welder and the welder has, as a rule, at least a half a day's work ready for him when he reports.

The matter of templates is another very important item. A poorly or improperly made template will make a poor fit which will cost more to weld and be of uncertain quality. Our templates used to be made by a shop man, but are now developed in the drafting room, and, as a result, some of the connections have been simplified and at the same time made stronger and more economical.

Welders Must Qualify for High-Pressure Pipe Work

All pressure pipe welding is done only by welders who have passed the required qualification test, and welders are, of course, required to stencil each weld. In addition, all such work is inspected by the construction inspector during the progress of the work and by the Operating Department when the job is completed. Their inspection routine includes a hydrostatic test wherever such a test is possible, together with the removal of one line joint in every twenty-five, and the same percentage of plugs trepanned from the joints of all piping.

The latter method is, in our opinion, the more efficient, as by removing a plug 1⅛ in. in diameter from a doubtful section of the weld, it is possible to investigate the inside of the whole welded joint, and form a reasonably accurate opinion as to whether it is satisfactory or not. These holes were plugged with pieces of pipe metal, cut to fit, properly bevelled and welded.

Many Reasons for Eliminating Flanges in Piping

Even aside from economies, the advantages of elimination of flanges in piping are substantial. This elimination, in many cases, permits closer spacing of pipe and provides an installation more pleasing to the eye. Doing away with wrench clearances permits in many cases the erecting of piping much closer to walls and partitions. In addition to these advantages, there is the permanent nature of the joint, and the elimination of gasket trouble and leakage together with consequent maintenance.

In our company all construction detail and design are subject to the approval of the operating departments. The attitude of the power-plant engineers has been conservative with respect to advancement of welding into the more important and higher-pressure lines. As yet no welded construction has been applied to lines such as boiler feeds and main steam, though it is becoming apparent that as experience is demonstrating the reliability of work done in the past the time is approaching when welding such important lines will receive favorable consideration. The principal reason for welding such lines will be the permanency of the joint and the elimination of bulky flanges, with any cost advantage as incidental.

The wisdom of this conservatism is apparent, as there can be no question that the present welding organization with its training, its qualification tests, and its inspection methods is far better qualified for such work than it was, say, three years ago.

Application of Welding to Underground Steam Lines

Welding was first adopted as standard construction for the underground steam lines of the central heating distribution system by The Detroit Edison Co. in 1928. This underground system consists of a network of surface and tunnel mains with surface and tunnel feeders tied in at various points to maintain a desired pressure on the system. The surface mains and feeders are buried at a depth of from 4 to 14 ft. and are from 4 to 20 in. in diameter. Tunnel mains and feeders, from 8 to 20 in. in diameter, are housed in tunnels, the depth of which varies from 20 to 60 ft. The average pressure on surface and tunnel mains is about 35 lb. per sq. in., while the pressures on surface and tunnel feeders vary from 120 lb. per sq. in. at the plant to 40 lb. per sq. in. at the feeding point. Services varying in size from 2½ to 16 in. in

diameter are welded to these mains and terminate at a valve just inside the customer's building.

The oxyacetylene weld is employed with excellent results on all underground steam surface mains and feeders. The Van Stone flanged construction is still standard for tunnel-main and tunnel-feeder construction. Welded construction is used for services 6 in. and larger, while smaller services have threaded joints. Welding flanges are used only in manholes on surface mains and feeders where valves and slip-joints are located, and on the larger-size services at the valve inside the customer's building.

Oxyacetylene Equipment for Tunnel and Street Work

One of the principal reasons for the use of oxyacetylene welding is its compactness and portability, which prove a distinct advantage for work in the steam tunnels and on surface lines, which are usually installed in streets where traffic is heavy and congested (see Fig. 7). Another advantage is that the same equipment can be used for both welding and cutting in the field on surface-line and maintenance work.

The use of welding has proved a great convenience and has assisted materially in lowering installation costs by speeding up construction, reducing maintenance costs, saving time and material in insulating, and facilitating the making of piping changes in the system. The length of time during which the steam main must be shut off, especially on repair work, is also considerably shortened, thereby reducing the inconvenience caused those customers concerned. Also the amount of special fittings, the replacement of which is attended with considerable delay, and the number of threaded joints (eventually a source of trouble due to leaks and corrosion) have been greatly reduced.

After a new line is welded in the trench, it is subjected to a hydrostatic test of 500 lb. per sq. in., and while the pressure is still on, an impact and vibration test is added by striking sharp blows with a 3-lb. hammer all around the pipe on each side but not on the weld. To date no trouble of any kind has been experienced with any welded joint after being so tested.

The savings in cost vary with each particular job. Savings can especially be made when offsets, branch lines, service lines, tees, crosses or elbows are planned in the installation, as parts for such can be cheaply and quickly fabricated.

Welding Eliminates Problem of Mislocated Service Fittings

Previous to the adoption of welding for surface mains, service fittings were located at regular intervals, when the main was installed, to care for future service requirements. Frequently, when the customer was ready for service, the location of these service fittings was such as not to be best suited to the customer's installation, and as a result extra fittings and pipe were required to make the connection. Services are now extended to the customer via the shortest route, since the main can be tapped at any point along its length.

Repair jobs and jobs requiring piping or fitting changes in some cases can be welded and installed with a saving of 50% or more compared with the cost of a threaded-pipe and flanged-joint construction. On new main installations the savings amount to as much as 20%, depending on the location, traffic conditions and subsurface obstructions. The more intricate the subsurface condition, usually the larger the savings effected.

Morehead Medal to Be Presented on May 25th

The Morehead Medal, which was awarded by the International Acetylene Association last fall to Gustaf Dalen, of Sweden, will be presented to the Swedish Minister, who will be the recipient on behalf of Mr. Dalen, at a dinner to be held at the Union League Club in New York City on May 25th at 8 o'clock. The Swedish consul will also be an honored guest.

High School Holds Two Classes in Welding

The Alhambra, Calif., high school has a progressive and enthusiastic class of welding students in the welding shop of the manual arts department, of which Carroll C. Rawson is the instructor in charge. Twenty-two students are enrolled in the advanced class, the course of instruction including practical welding jobs of various kinds both in the electric-arc and oxyacetylene processes. Sixty other students comprise the "coming up" class who are enrolled in the preliminary instruction course which includes the fundamentals of iron work, practice in light ornamental iron, forge work, etc. Each student in the introductory course is given the opportunity to develop himself according to his aptitude and fitness for the work. If the work appeals to him and he so desires, he is, according to his ability and progress, advanced to the more difficult and technical phases of the welding art.

An electric arc-welding unit, together with practically all modern makes of acetylene torches and regulators, both of the injector type and the equal-pressure type, are included in the equipment of the school shop. The proper care and operation of all equipment is of course explained, and it is required that this care be practiced by each student in his work.

Several important repair jobs of welding in different departments of the school, saving considerable sums of money, have been done at different times by the advanced students.

Receives Contract for Moving Oil Tanks

A contract for moving 24 55,000-barrel oil tanks in the Texas and Oklahoma oil fields has been awarded the Pittsburgh-Des Moines Steel Co., the Des Moines, Iowa, office of which is doing the work. The sides and bottoms of these tanks are of riveted construction. The rivets will be cut by blowpipes and the tanks shipped in parts and assembled at the new locations. The tops of the tanks, which are of wood construction, approximately 115 ft. in diameter, will be replaced with all-welded roofs.

H. H. Moss Awarded Miller Memorial Medal

The Samuel Wylie Miller Memorial Medal was awarded by the American Welding Society, at the recent annual meeting, to H. H. Moss, of The Linde Air Products Co., New York, "for his achievement in the application of fusion welding and oxyacetylene flame cutting." Mr. Moss is well known for his investigations into the use of oxyacetylene welding and cutting in structural work, oil and natural-gas transmission projects, and transportation equipment. He gave valuable aid in 1931 to the Committee on Technological Development under President Hoover's conference on home building and home ownership. More recently Mr. Moss has been giving careful study to the new field of flame machining.

H. H. MOSS

Fig. 1. Colonial-Design Elevated Tank of Welded Construction Built for Tallahassee, Fla.

Welded Elevated Tanks Noted for Beauty and Utility

SEVERAL elevated tanks of striking appearance have recently been built in which welding has played an important part. These are particularly noteworthy as indicating a very definite trend toward improving the appearance of elevated steel tanks, particularly the larger ones for municipal service.

Attempts at beautification in the past have taken the form of expensive enclosures. The present tendency is to design the structures so that they will be pleasing in themselves and thus eliminate the use of costly materials for ornamentation only by combining beauty and utility.

One of the latest examples illustrating this trend is the Colonial design tank built last fall for the city of Tallahassee, Fla., by the Chicago Bridge & Iron Works. This tank, shown in Fig. 1, has a capacity of 400,000 gallons, and utilizes tubular columns, a radial-cone bottom and a dome roof. The bottom of the tank is at an elevation of 78 ft. The first 7 ft. 2 in. of depth above the spring line in the roof is utilized as a portion of the tank capacity.

Novel Tower Design Makes for Pleasing Appearance

The structure departs most radically from standard designs in the tower. It consists of eight 33-in.-diameter tubular columns of welded construction, placed in a circle 41 ft. 6 in. in diameter. Inasmuch as this is considerably less than the 56 ft. diameter of the tank shell, the radial girders of the tank bottom are supported on the inner end by the 4-ft.-diameter riser and cantilevered over the cylindrical columns. The tower is particularly open in appearance, as there are no struts between the columns. This gives a single-panel effect, with full-length X-bracing rods between alternate columns. By utilizing the radial-cone type of bottom, utility is combined with beauty. The construction of the bottom is illustrated in Fig. 2.

The total range in head between the high and low water levels in the tank is only 24 ft. This shallow depth not only reduces the variation in pressure in the mains but it reduces operating costs by cutting the average head against which pumps must work.

The city plans to build an ornamental base for the tank, with broad steps leading up to a mirror pool around the riser, encircled by an ornamental railing. Four dome sprays in the pool will be illuminated with colored lights from below, and the upper part of the tank shell will be floodlighted.

This tank is set in the midst of a high-class residential section of the city, but the beauty of the welded structure has been a point of interest and a source of pride.

The city of Evanston, Ill., also recently had built an elevated tank with a welded radial-cone bottom, the shop work being done in the Chicago plant of the Chicago Bridge & Iron Works. This tank, which is considerably larger than the Tallahassee tank, has a capacity of 1,500,000 gallons, and is illustrated in Fig. 5. It is 104 ft. in diameter and the bottom is 92½ ft. above the ground. There is a range of only 25 ft. between the upper and lower water levels.

Fig. 2. Welded Bottom of 400,000-Gallon Tallahassee Tank.

Radial-Cone Bottom Has Sixteen Girders and Troughs

The bottom, a view of which is shown in Fig. 6, consists of 16 radial and essentially horizontal girders framed into a 10-ft. diameter riser pipe and into the tops of the two circles of interior columns, and of 16 radial troughs, each trough being a portion of a right cone. Each girder is all-welded. These troughs and girders are shown in Figs. 3 and 4. The top flange is a 2½-in.-square bar,

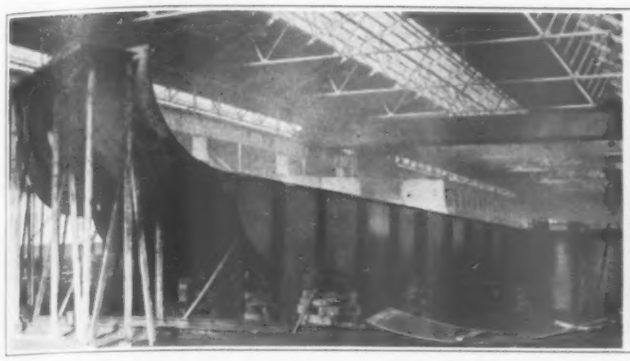


Fig. 3. Each Section of the Bottom of the Evanston Tank Is Supported by Radial Girders.

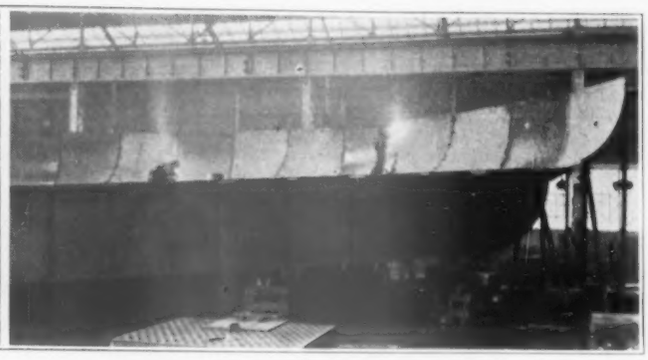


Fig. 4. Welders at Work on One of the Bottom Sections in Plant of the Chicago Bridge & Iron Works.

with the upper corners planed off tangent to the trough curve; the web is a 60 x $\frac{3}{8}$-in. plate, and the bottom flange is a 12 x $\frac{1}{2}$-in. plate. The radial edges of the $\frac{3}{8}$-in. trough plates lie on the sloped corners of the top flanges of the girders and are welded together, and to the girder, by weld metal laid between the plate edges and upon the girder. All other joints connecting the bottom plates are of the single-V butt-welded type. Only shielded-arc electrodes were used.

All Curved Plates Were Shaped Cold Before Welding

The troughs sag between the girders, and are inclined to the horizontal sufficiently to drain into the riser. At their outer ends the troughs curve upwards into a tangent connection to the vertical

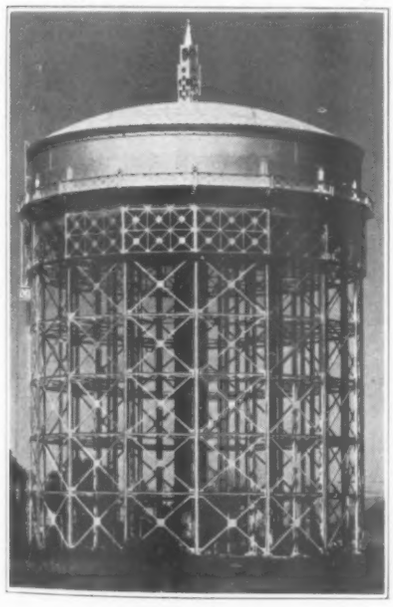


Fig. 5. Completed View of 1,500,000-Gallon Tank Built for Evanston, Ill.

shell. These curved plates, which define warped surfaces, were shaped cold between a lower ring die and an upper cam-actuated plunger, between which they were shifted by artisans whose skill excites the admiration of all observers.

One who has watched this process loses much of his fear of plastic strains in steel. The result of dishing is to increase the elastic and reduce the plastic range of the metal being worked.

The shop joints in the bottom plates were welded from both sides. The field

Fig. 6. Inside View of Evanston Tank Bottom as It Was Being Welded in the Field.

joints were welded from the top side only against 1 x $\frac{1}{4}$-in. backing-up strips.

In the welding of such structures as this, one troublesome factor is shrinkage. The girders are shortened appreciably due to shrinkage, and allowance must be made for the fact that shortening of trough plates is apt to widen the gap between the plate edges along the unwelded seams.

Noted Men to Discuss Pressure-Vessel Welding

A noted array of talent will be present at the meeting of the Chicago Section, American Welding Society, to be held on May 19th, to discuss various of the A.S.M.E. Code requirements pertaining to the welding of pressure vessels. The meeting will be held in the Florentine Room at the Congress Hotel, starting at 7:30 p. m. promptly, and will be preceded by a dinner at 6 o'clock at the same place.

Comfort A. Adams, of Harvard University, will represent the Society at this meeting and will make a preliminary statement as to the origin and purpose of the meeting. This will be followed by talks by E. R. Fish, chief engineer of the Hartford Steam Boiler Inspection & Insurance Co., Dr. H. H. Lester, director of research at the Watertown Arsenal, and T. McLean Jasper, director of research of the A. O. Smith Corp.

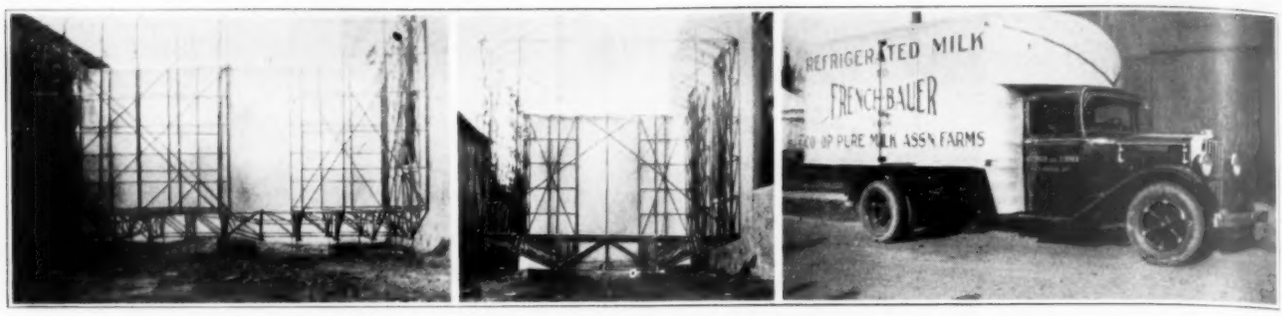
Mr. Fish's talk will include a brief history of the formation and method of operation of the Boiler Code Committee, with particular reference to the development of the welding rules which will be under discussion. Dr. Lester's talk will deal mainly with the use of X-rays for inspecting welded structures. Stress-relieving will be given particular consideration by Mr. Jasper in his talk. A discussion will follow the meeting, and it is expected that this will bring out from many users and manufacturers who will be present their experiences regarding X-raying, stress-relieving, and other requirements of the code, together with opinions derived from such experiences.

Purchasing Agents Show Interest in Welding

At a meeting of the South Bend Purchasing Agents Association, held in South Bend, Ind., on April 12th, J. F. Franzen and M. M. Weist of the Chicago office of the Air Reduction Sales Co. gave talks and showed the motion picture entitled "The Magic Flame." This was followed by a demonstration on liquid air, in which the use of liquid air for expanding fittings was shown. The meeting was well attended and much interest was evident.

Philadelphia Group Hears Paper on Shipbuilding

At the meeting of the Philadelphia Section, American Welding Society, held on April 17th, Lt.-Commander A. I. McKee, U.S.N., presented an excellent paper on "The Influence of Welding on Ship Construction" before an audience of 85. The following officers were elected for the ensuing year: Chairman, Charles M. Rusk; vice-chairman, A. G. Desch; treasurer, R. D. Thomas; and secretary, H. E. Hopkins.



Aircraft Tubing With Welded Joints Forms the Body Framework of the Refrigeration Truck Body Shown at the Right.

Truck Refrigerating Body Made of Aircraft Tubing

A novel use of welded aircraft tubing is shown in the illustrations. This is a truck refrigerating body, known as the Air-Lite body, built by the Promoting Utilities Distributing Co., Alexandria, Ky. This body is composed of various sizes and gages of aircraft tubing welded together into a single unit for mounting on a truck frame or chassis with rubber shock pads. The superstructure before covering somewhat resembles a small dirigible.

The weight and torque of the body is engineered and stressed on the same principle as that of a large airplane, in which the trusses are made up and welded together in a jig, then brought together for the assembly of the body. There are three main assembly trusses.

The bottom or floor trusses, which support the main pay load of the body, are attached directly to the frame of the car with a bolt welded to one of the main verticals of the truss. This bolt passes down alongside the frame and attaches to a special clamp that hooks onto the bottom channel of the frame.

Each side truss, which supports the inside wall, roof and part of the pay load, is composed of two vertical tubes well trussed together and spaced 2½ in. apart or 3½ in. overall, which determines the dead-air space.

The roof is arched and built on the same principle of trussing as the floor and side trusses. It too has a dead-air space, from 2½ to 6 in.

The floor is composed of two layers of wood, the top flooring being a hardwood treated with oil. Between the layers is a sterilizing hogs'-hair blanket which acts as the dead-air space for the floor.

The inside walls are of ⅜-in. California redwood, which is nailed securely to a hardwood strip bolted to the side trusses.

The ceiling is of very heavy canvas or duck sewed together and stitched to the bottom tube of the roof truss somewhat like an airplane wing.

The insulation is composed of a sterilized hogs'-hair blanket on the inside and another on the outside, both making a complete wrapping of the entire body, with an extra blanket on the roof to help intercept the heat from the sun's rays.

The body is entirely covered on the outside with a very heavy canvas or duck treated with a good grade of aircraft dope, and the ceiling is likewise treated. Aluminum color is added to the dope for the last coats.

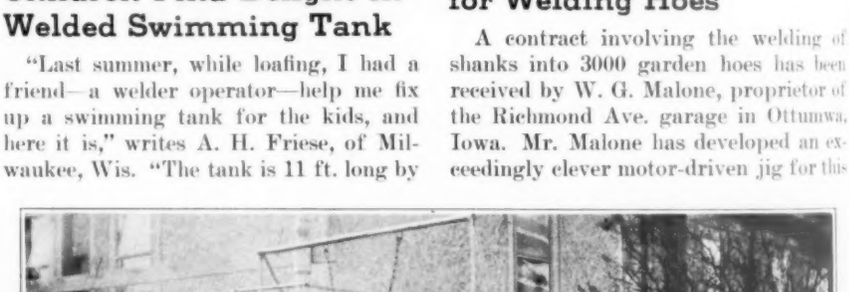
The floor will stand a load of 55,000 lb. per square foot of floor area. The weight of the completed body is only 1700 lb.

The first body of this type built by the Promoting Utilities Distributing Co. has been in service for two years in a section of Kentucky that has few improved roads. It is still in good shape and has had no repairs.

Children Find Delight in Welded Swimming Tank

"Last summer, while loafing, I had a friend—a welder operator—help me fix up a swimming tank for the kids, and here it is," writes A. H. Friese, of Milwaukee, Wis. "The tank is 11 ft. long by 5 ft. wide, 1 ft. deep on the shallow end and 2½ ft. on the deep end. A 1-ft.-wide wooden platform runs around the tank, and sections of pipe welded together make the railing. Even the ladder is welded of pipe. The tank is of 3/16-in. plate and holds 550 gallons of water. It takes 1¼ hr. to fill it by garden hose, but only 1 hr. to drain it by pipe underground to the alley sewer. The tank slopes from shallow to deep water. Our two kids, with about five other kid friends, have a helluva time regularly during the warm summer months. A pipe frame and trapeze are provided from which they can drop into the water.

"This tank is above ground, and next year, or when the kids get taller, I'll add on another 5 or 10 ft., making this addition about 3½ ft. deep, and continue adding until the total tank is about 20 ft. long. Then I'll increase the width to about 10 ft., and we'll be all set, and of course the old man will be in the tank with the kids."



Built for the Children, This All-Welded Swimming Tank Will Some Day Be Enlarged So the "Old Man" Can Take a Dip.

Uses Motor-Driven Jig for Welding Hoes

A contract involving the welding of shanks into 3000 garden hoes has been received by W. G. Malone, proprietor of the Richmond Ave. garage in Ottumwa, Iowa. Mr. Malone has developed an exceedingly clever motor-driven jig for this work which lines up the shank and hoe and revolves the two parts at welding speed. With this machine, the welder merely strikes his arc, then steps on the starter peddle, and holds a steady arc for a few seconds.

· E D I T O R I A L ·

Equipment Bought Now Will Return Large Dividends

• Rising prices are being reported more frequently to-day than price reductions. The trend in this direction bids fair to continue and in time to culminate in a seller's market, with prices at a considerably higher level than the present. This is interpreted as a stiffening demand for raw materials and finished goods, a bettering of the position of many industries through increase in inventory values, an easier credit situation, and a general feeling of optimism. In this connection the fact should not be overlooked that the beginning of a long, gradual climb in prices marks a particularly important period. If the price index is to continue its present trend, capital expenditures made during the next twelve months will give greater returns to the investor than if spent in any other period. It is the history of American industry that when prices and wages are near their peak and money is easy to get for plant extensions and improvements, industry takes on heavy obligations that act as a millstone around its neck and all but drowns it in the leaner years to come; and these obligations, which appear as overhead and can't be dodged outside of courts of law, are in large part responsible for those conditions that bring on the lean years after the years of plenty. This is a condition that industry itself will correct as it acquires a better understanding of economic forces and their effect on values and on depreciation of plant equipment. It goes without saying that a great deal of equipment sold in 1928 and 1929 benefitted neither the buyer nor the seller. When production dropped to a low point, the buyer found that the overhead represented by this new equipment was a heavy burden to him, and the seller assumed heavy obligations in capital investment in order to turn out the equipment at a time when his plant capacity was already overtaxed. This pyramiding of capacity was accompanied with an increasing plant overhead in the form of interest on bonded indebtedness and notes and depreciation on plant equipment. These heavy obligations could be met so long as output continued at a moderate rate; but when output dropped off and reached almost the vanishing point, it became necessary to draw on surplus and enact rigid economies, and in many cases even these measures were not enough. If much of the high capital expenditures made in times of high industrial activity could be shifted to such a time as the present, the peaks and valleys of the "business cycle" would be much reduced in extent. This would not only be good business, but also good economics. When the slogan "Buy Now" was emblazoned on billboards everywhere, the shrewd business man bought no more than for his immediate needs. But now, when the slogan is all but forgotten, industry should be buying to take advantage of low prices.

We're Bullish on Stainless Steel

• The expanding markets for the austenitic stainless steels have been further boosted by huge orders for brewery equipment. The output in these stainless steels did not drop off in proportion to that of steel itself during the days "when the depression was on." Despite the fact that many persons used to be skeptical of the weldability of stainless steel, in its fabrication a great deal of welding is being employed. Welds in stainless steel that might be regarded as perfect used to be very rare. Many advances in the welding of this material have been made in the past three or four years, but the successful welding of it seems to be largely dependent on the use of a proper rod and flux. Of course, what is termed a "successful weld" in stainless steel might be subject to personal interpretations affected by the particular application to be made of the steel. For example, a weld that shows pitting or evidence of intergranular breakdown in a zone near the weld, would not be satisfactory in a milk pasteurizer, but the same weld might be considered "successful" or satisfactory for a teller's cage. Recent investigations into heat treatment, welding, and working of stainless steels are leading to the development of steels and of electrodes that will depend less on the human equation for the obtaining of satisfactory welds. With fewer rejections of completed equipment and with increased reliability in service, which these developments should lead to, there will undoubtedly follow an even greater use of these steels and equipment for welding them.

All Join in the Refrain, "Come to the Fair"

• A Century of Progress, the Chicago World's Fair, opens its doors May 27th, five days ahead of scheduled time. This Fair holds an especial interest to professional men, and particularly to engineers. Its conception lay largely in the minds of engineers, and it was they who in large measure carried out the plans for the Fair. This great exposition, three miles in length, on which about ten million dollars has been spent, was built without a cent of public funds, but through subscriptions of individuals and business firms, many of whom have contracted for space for displays. To the architect, the Fair marks a new adventure in modern architecture and in the treatment given towers, structural columns, etc. To the structural engineer and designer, the Sky-Ride is of absorbing interest and demonstrates a method for keeping down weight and cost in long spans, by a novel application of structural towers and cableways. Demonstrations in the physical sciences will be in evidence in the science and electrical buildings, as well as in the huge agricultural building. Having been planned and executed by engineers, the Fair will be of unusual interest to all members of that profession.

Get "*H. O. T.*" on Welding

■ Edited by
H. O. T. RIDLON
Welding Consultant, Joliet, Ill.

[This section is dedicated to Better Welding and Better Welding Shops. Suggestions and criticisms are invited.]

How to Figure Costs

Question: What is a fair method of charging—a system to keep such cost and eliminate guessing?

Answer: The fairest method for shop owners to figure charging for a certain job is to take all your cost. For instance, it may be $5.00. Of this amount, figure 50% for overhead, or $2.50. Total these amounts and we find we have $7.50 for costs and overhead. Now you ask how about profit? That's fair enough because no shop can live without profit. So of your costs and overhead take 50%; or in our given figure, we now have $3.75 for profit with a total cost to the customer of $11.25.

In the Welding Encyclopedia, under the caption "Cost Card" is a very simple but satisfactory cost card. This can be elaborated on, but be careful not to go too far in fancy cost cards. In Stuart Plumley's book on oxyacetylene welding is a highly elaborated and satisfactory cost card.

Know Your Metal Before Welding

A number of shops have written in wanting information about the welding of white chilled iron rolls. Perhaps some discussion on this should be in order. I am not going to go into details in this issue and would like to invite what information and experience my gentle readers have had in this line. So let's hear from you on this subject. However, we might say this about chilled iron. Be sure you know your metal. You might be fooled. A manganese crusher roll often looks like a chilled iron roll, and the reverse is also true. A small magnet will quickly tell this story for you. If your magnet does not take to the piece, you may be sure your problem is in manganese and you can forget about chilled iron.

But this is the important thought: Know what you are up against and how to do the job or work of that kind, because there is no fun in putting several hundred dollars with a job and then have it go hay-wire.

Scrap That Old Acetylene Generator

Hint: Don't attempt ever to build your own acetylene generator! You may find the cost—also your shop—too high! Also, if you've got an antiquated one—better order a new one that's been approved by the Underwriter's Laboratories and help bust this depression, not yourself. When the new one arrives, work on the old one with a sixteen-pound sledge, and then give it a fitting final resting place, if it's not too late.

"Bob" Kinkhead of *Industry and Welding*, your squib in the April issue, "Nerts to you," was swell, and I salute you!

Ideal Machine-Parts Arc-Welding Shop

By ARTHUR J. STOCK, JR.

(Extract from paper entered in the Second Lincoln Arc Welding Prize Competition, sponsored by The Lincoln Electric Co., Cleveland, Ohio.)

The ideal machine-parts arc-welding shop should be a light, clean plant, which employs the most capable of workmen. The employees should understand that there is more required of them than just welding two pieces of metal together so that they will stand up under strain. They should have an understanding of the proper handling of parts which have been machined and should know how such parts should be welded in order to produce the minimum of warpage.

Accuracy of location of one part with respect to another should be carried to the limit of practicability so as to enable as much machine work as possible to be done prior to welding. The results of the shop's experience as to the degree of accuracy obtainable under various conditions should be made available to all engineers. Tolerances can then be made suitable for the most inexpensive method of construction which will produce the part in question satisfactorily.

A machine-parts arc-welding shop should be equipped with simply made universal holding means. Such means may consist of heavy angle boxes that will hold the average part by their own weights, V-blocks, step blocks and shafts with cones to hold tubing and the like centrally. These universal fixtures could be originally made very simply. More complex units may be added as experience dictates.

The other equipment of a machine-parts arc-welding shop should enable it to fashion the metal parts to any required shape and weld them together in the best possible manner. It should also be capable of normalizing the various welded structures after welding and of giving them any further heat treatment necessary.

Such a shop should be located convenient to warehouse stocks of structural shapes, plates, rods, pipe and tubes. It should be able to obtain on short notice forged or rolled rings, alloy steels and non-ferrous metals, and be capable of welding these materials as well as steel.

The savings made possible by the use of welded construction over other constructions for machine parts, which are purchased in fairly small quantities, creates a demand for machine-parts arc-welding shops. Because of substituting welded construction for other constructions, savings as high as 88½% in the cost of parts have actually occurred in the author's experience, and a sizable volume of purchases was made of these parts. Further, purchases of welded machine parts would have been greater during the same period if a reliable source of supply that could satisfactorily fabricate all possible designs, existed locally. Those parts, which were purchased through the author's office, are typical of those purchased through many other consulting offices and manufacturing plants and, therefore, they may be considered a fair sample of the existing demand.

It would be rather futile to hazard a guess as to the dollar volume of potential arc-welded machine-part business that could be obtained, for it could not be much more at the present time than a guess. Much of the potential business does not show itself clearly, as the parts are now made by other methods of manufacture. However, it is a type of business that a good sales engineer can develop by pointing out the savings to be had when welded construction is employed. The demand for welded steel machine parts that can be created is the result of the savings and the other advantages of welded construction. It has been demonstrated that the actual cost of welded machine parts is usually considerably less than other constructions, hence an unusual opportunity for profit exists in the manufacture of arc-welded machine parts.

The shop that starts today has the advantage of experience and goodwill over those that start in the future; and therefore it can, with good management, continue on a profitable basis with its lower production costs and lower sales resistance.

A worthwhile estimate of the probable amount of business and probable profits of a machine-parts arc-welding shop can not be made in a paper of this type, as the biggest single factor in any business, which is management, must be assumed. Excellent management can make a success of little opportunity, while poor management often fails even under the most favorable conditions.

The demand for arc-welded machine parts can be increased considerably by proper sales methods, and therefore sizeable profits should accrue to those that satisfy this demand.

New Equipment

Transparent Cups Add Comfort to Goggles

It is claimed by Willson Products, Inc., Reading, Pa., that their new transparent cup goggles goes to the very seat of the trouble in removing the cause for complaint against goggle wearing. They point out that even the most chronic "goggle kickers" are in a measure justified in their complaints and also remind us that the greatest single reason for the appalling number of eye accidents in industry is "goggles not being worn by workman at time of accident."

The cups of the new Willson Goggle are made of a transparent material which enables the wearer to perceive objects through them. Light passes through the walls of the cups undimmed and permits an entirely normal eye condition; the "blinder" feeling is entirely eliminated, and the operator obtains a visual comfort heretofore not possible with any type of goggle.

No sacrifice of the elements that go into making a good goggle was necessary to obtain cup transparency. The goggle is sturdy, has strength to withstand impact, is spark proof, and is extremely light in weight. It was found possible because of this last advantage to make a roomier, better-ventilated goggle of less weight. The result is a goggle which

New Transparent-Cup Goggle.

serves well for general all-purpose use and can also be worn over spectacles.

Heretofore special models for over-spectacle wear meant carrying a stock of special replacement parts as well as special goggles. This is now made unnecessary, as the new goggle definitely takes the place of at least two styles.

This goggle is also made in a black composition cup model for welders with two sizes of Willson-Weld lenses in any shade desired, 50 mm. and 45.8 mm.

New Stainless Electrodes for High-Quality Welding

The firm of Shuler & Stafford, 7242 Bennett Ave., Chicago, Ill., announce that they are now ready to market coated electrodes for the welding of alloy steels. Of particular interest to the trade is an electrode for the welding of stainless iron that is said to give a deposit which is practically free of carbonaceous material and is highly resistant to corrosion. Electrodes have also been developed for the welding of manganese steel in railway work and for other applications.

The two principals of this new firm are E. J. Shuler, consulting metallurgical and welding engineer with Landis & Landis, and J. E. Stafford, who for 16 years was with the Inland Steel Co., principally as purchasing agent, and later entered the manufacturing and contracting fields.

New A. C. Welder Has High Power Factor

David H. Smith & Sons, Inc., 51st St. and Second Ave., Brooklyn, N. Y., have placed on the market a portable A.C. arc welder of the plug-in type, operating from 110 or 220 volts, and particularly designed for use in small automotive repair shops, ornamental-iron works, and the smaller type of factory where existing power facilities are inadequate for operation of a standard-size machine. The new unit is said to incorporate new principles not heretofore employed in electric arc welders, with a high power factor and high efficiency. The Smith-Waters standard line of arc welders up to 400 amperes are now available for high-power-factor operation.

"Z-Ray" Now Equipped With Welding Shield

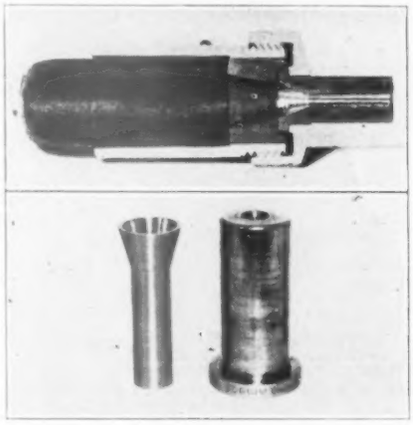
After research and service trials covering several years, the Electric Arc Cutting & Welding Co., Newark, N. J., announces for observers, inspectors, and welders such as who use a shield, the "Z-Ray" for inspection of welds. The shield is equipped with a magnifying glass and colored lens so the arc deposit can be viewed larger while being made.

"The best inspector," states C. J. Holslag, president of the company, "is the welder himself. It has always been my experience that welders have been very proud to do their best. By making the welding deposit appear five or six times as large as it really is, the 'Z-Ray' brings out the structure of the weld so forcefully there is no excuse for not joining the deposit to the parent metal or for leaving slag holes or gas holes in the deposit itself."

Due to the care which must be taken of the eyes, the "Z-Ray" is furnished in a welding shield only, although the shield can be provided with head straps.

Sand-Blast Nozzles With Durable Inserts

Sand-blast nozzles with inserts of borium to resist the abrasive effects of the sand, are now being made by the Stoody Co., Whittier, Calif. The insert is mounted in the steel shell of the nozzle with a rubber cushion. Borium, of which



Assembled and Disassembled Views of Sand-Blast Nozzle and Borium Insert.

these inserts are composed, is an extremely hard metal—so hard it will scratch corundum and will easily cut glass. Inserts of this material make replacement infrequent and comparatively inexpensive. The Stoody Co. guarantees each nozzle to give not less than 300 hours' service. These nozzles are said to be highly efficient. They are made in several sizes, the most common being ½, 5/16, and ⅜ in. inside diameter.

X-Ray Paper to Take Place of Film

The St. John X-Ray Service Corp., 505 Fifth Ave., New York, N. Y., announces the development of a paper to replace costly celluloid film. It is claimed for this paper that its price is less than half that for film, it is easier to handle, will dry faster, needs only one intensifying screen instead of a pair, and is as fast as film and will give as much contrast. The 2% marker is readily recognizable. Two sheets are exposed simultaneously in one cassette. This has the advantage that one negative can be retained while the other one goes along with the material. This X-ray paper, it is claimed, can be developed in 3 minutes at 68° F. when using St. John special chemicals.

Trade Literature

Track welders for maintenance work on railway right-of-ways and bridges are described in two leaflets issued by The Lincoln Electric Co., Cleveland, Ohio. One leaflet deals with a quick-removable unit equipped with a 200-ampere welder, making it possible to repair at least 250 ft. of track at one derailing, using ¼-in. electrodes. The welder described in the second leaflet is of the self-propelling type, and is equipped with a 300-ampere generator, allowing ¼-in. electrodes to be used at a distance of over 1000 ft. from the machine, so 2000 ft. of track can be repaired with one derailing. All machines have auxiliary generators for grinders and other tools. Both leaflets also describe the electrodes used for welding frogs, crossings, switches and battered rail ends.

Old and new methods of manufacturing genuine wrought iron form the subject of a booklet entitled "The New Story of Ancient Wrought Iron," issued by the A. M. Byers Co., Pittsburgh, Pa. Illustrations show the methods used in the Byers process of wrought-iron making and these are contrasted with the hand-puddling process. Consideration is given to the effect the various operations in manufacturing wrought iron have on the characteristics of the iron.

"Grinding, Polishing, Buffing Monel Metal and Pure Nickel" is the title of bulletin TS-5, recently issued by The International Nickel Co., Inc., 67 Wall St., New York, N. Y. This publication deals with brushes, wheels, abrasives, buffing compounds, etc., and gives the procedure for roughing down welds and blending a weld area into a finished sheet. Consideration is also given to the removal of marks from drawn products and to finishing operations.

"Cutting, Brazing, Heating With Liquefied Petroleum Gases" is the title of a leaflet issued by The Bastian-Blessing Co., 240 E. Ontario St., Chicago, Ill. Torches and complete outfits for cutting, brazing, soldering, lead burning, and heating, are described, these being designed for use with propane, butane, and other liquefied petroleum gases. Regulators are listed for oxygen tanks, propane and butane tanks, and butane-methane tanks.

"Atomic-Hydrogen Arc-Welding Equipment" is the title of bulletin GEA-823D, published by the General Electric Co., Schenectady, N. Y. This publication gives the reasons for atomic-hydrogen welding, its advantages, where it can be used, and the operation of the equipment. The equipment is illustrated and application views are shown.

Portable cables for arc welders, mining machinery, electric shovels, etc., are described as to application and construction in bulletin GEA-1733, published by the General Electric Co., Schenectady, N. Y. Long life, toughness and other advantages are claimed for the tellurium-compounded all-rubber jacket with which these cables are equipped.

Carbonic-gas regulators are listed in a folder just issued by the Torchweld Equipment Co., 1035 W. Lake St., Chicago, Ill. These regulators are widely used for the dispensing of draught beer and other beverages using carbonic-acid gas. Space is also given to the Torchweld No. 4NF Non-Flash welding unit.

The design of welded crankshafts is the subject of Application Sheet No. 33, Series 2, recently published by The Lincoln Electric Co., Cleveland, Ohio. Designs are shown for extended cranks, for a crank between two bearings, and a crank of multiple throws. Diagrams illustrate details of these designs.

"Nolap" abrasive sleeves for use with portable grinders are described in an illustrated folder published by The Cleveland Container Co., 10730 Berea Road, Cleveland, Ohio. It is pointed out that considerable economy results from the use of these sleeves with expanding rubbers for mounting.

Portable electric insulated cable, for arc welding and other purposes, is listed in various types and capacities in bulletin GEA-1728A, issued by the General Electric Co., Schenectady, N. Y.

News of the Industry

Aluminum Welding and Soldering Supplies

A complete aluminum welding and soldering supply service has been announced by Wooldridge & Larson in Gastonbury, Conn. This company has brought out "Almare" electrodes for producing neat aluminum arc welds without porosity or discoloration and with minimum distortion, also "Alflux" fluxes for the gas welding of aluminum, the No. 2 flux also being suitable for welding Dowmetal and magnesium. Other products include 5% silicon aluminum wire for the gas welding of aluminum, and "Alsod" solder and soldering flux for the soldering of aluminum parts. Wooldridge & Larson's products are being distributed by supply houses in most of the principal cities.

Welding Courses Prove Popular

Completion of the recent one-week condensed welding course given in Cleveland by the John Huntington Polytechnic Institute and The Lincoln Electric Company was marked by the largest attendance of any of the four similar courses given during the winter. Included in the registration were men from Germany, Japan and Sweden as well as from ten different states. The success of these one-week courses in designing for welding has led to the decision to repeat the courses in the fall, according to A. F. Davis, vice-president of The Lincoln Electric Company.

"Meanwhile our own welding school will continue to operate full time," said Mr. Davis. "Due to many recent developments in welding and to the fact that not a few manufacturers are using this slack period to train key men, we believe that the school is filling a pressing need."

The Lincoln welding school not only trains operators but provides a background course for foremen, superintendents, engineers and others who desire to learn the practical side of arc welding and to familiarize themselves with the operator's problems. The usual length of the course is about four weeks.

Torchweld Moves to Larger Quarters

At a recent meeting, the officers and directors of the Torchweld Equipment Company decided to move the offices and plant to larger quarters on June 1st. The new location at 1035 W. Lake St., Chicago, Ill., will more than double the floor space of their former quarters.

New machinery and fixtures are being added to enable the company better to serve the many satisfied users of Torchweld Non-Flash welding and cutting ap-

Why welders believe that Tobin Bronze *is* better!

Its low melting point
Its free-flowing qualities
Pre-heating seldom required
Minimizes distortion
Makes dense, tough welds
Uniform in composition
Made by Anaconda
Sold by leading distributors

THOUSANDS of satisfied users of Tobin Bronze...the original low melting point bronze rod...will accept no other brand. As many welding foremen have said, "Tobin Bronze must be better...my men swear by it."

Of the complete line of 7 Anaconda Copper-alloy Rods, Tobin Bronze is the most generally used... because of its widespread acceptance as the *ideal* rod for the general oxy-acetylene welding of cast iron and malleable iron. It melts at 1625° F; preheating is usually unnecessary.

The uniform composition and unvarying quality of all Anaconda Welding Rods are due to the metallurgical knowledge gained by The American Brass Company during a century's manufacturing experience. A complete line of low melting point Anaconda rods is available through leading distributors...usually shipped in bulk, but also obtainable in clearly labeled ten-pound packages. For complete information, ask for Publication B-13.

There is a suitable Anaconda Filler Rod for every bronze-welding purpose. Principal Anaconda Welding Rods, with their melting points, are listed below:

for oxy-acetylene welding	
Tobin Bronze*	1625° F
Manganese Bronze	1598° F
Brazing Metal	1634° F
Electrolytic Copper	1981° F
Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F
for arc welding	
Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F

*Reg. U. S. Pat. Off.

ANACONDA
from mine to consumer

THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Connecticut
Offices and Agencies in Principal Cities
In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ontario

ANACONDA WELDING RODS

paratus. The firm recently announced a new line of welding and cutting equipment, together with carbonic-gas regulators to be used in connection with the dispensing of draught beer, which have been favorably received by the trade. A new price list will be issued about June 1st.

The officers present at the meeting were: C. K. Anderson, president; J. C. Kirchner, vice-president; Chas. F. Egbert, treasurer; and J. L. Jensen, secretary and general manager.

Welding and Machine Shop Housed in Street Car

Those who marvel at the efficiency of a railroad diner, particularly the kitchen end, where so much is done in a very small space, can reflect on the accomplishment of Don A. Compton, 105 Bank St., Keokuk, Iowa, who opened a job welding and machine shop in a 31-ft.-overall standard-width street car. He purchased this car for $75 and paid $25 more to have it moved into his yard. His equipment consists of an air compressor, two pedestal grinders, a 42-in. lathe, and a drill press, all belt-driven; also a hand-driven forge, a flexible-shaft grinder, a stove, an oxyacetylene welding unit, with plenty of work-bench space and an ample stock of small tools. To move the shop, it is necessary only to jack it up, put wheels under it, and be on the way.

Because of the small quarters, everything must be kept in its proper place, says Mr. Compton, but this saves time, as it is not necessary to hunt for tools. Everything is available by taking not more than two steps in any direction, and yet there is no feeling of crowdedness.

"Where Welding Is Not a Side Line"—Slogan

Milo Meyer, welding-shop owner operating a shop at 975 South Market St., in Inglewood, Calif., has entered into a partnership arrangement with Fred E. Woodbridge, who recently came to the west coast from the mid-continent oil fields, where he was connected with the Humble Oil Co. as welding inspector in the pipe-line construction department.

The slogan of these partners in their newly organized business is "Where Welding Is Not a Side Line."

Mr. Woodbridge, several years ago, was awarded the contract for laying the first water pipeline which brought water over the continental divide. This line, which was 26 in. in diameter and acetylene welded, was laid in Montana.

Mr. Meyer, who came to California about four years ago from Oklahoma City, has had over twenty years of experience in welding, and was an operator for Oxweld in the early stages of the welding industry's development. He was an instructor in charge of an army and navy welding school during the World War.

The welding department of the Santa Fe Springs field shops of the Union Oil Co. of California recently underwent extensive changes resulting in added efficiency and convenience for the welding operators. A large pipe-threading machine has been removed, providing extra working space and more room for welding equipment. Also an interesting and practical feature has been added by building in, along one side of the shop, individual lockers for each welder's set of regulators, torches, and other equipment. By this arrangement, time is saved by each welder in locating and adjusting his regulators, etc., and thus he gets his work under way more quickly each morning.

The pipeline construction engineering firm of Brokaw, Dixon, Garner & McKee, of Houston, Texas, are in charge of the laying of a 10-in. welded gas transmission line from the Conroe gas field to Houston. The line, which is being constructed for the Moran Corp., of Houston, will have a capacity of from 35,000,000 to 50,000,000 cu. ft. of gas daily. The gas, it is stated, is for industrial consumers only.

The Dix Machine & Welding Works recently opened for business at 3421 Mines Ave., Los Angeles, Calif., under the management and ownership of E. H. Daubendick. Light acetylene welding jobs of all kinds will be featured, in addition to machine work and general repairing. Mr. Daubendick has had about 10 years of welding experience, and was associated with the Pacific Pipe & Supply Co. for 11 years.

"Rudy" Ostronik, formerly of the Advance Welding Works, 741 South San Pedro St., Los Angeles, Calif., recently opened a new welding shop at 766 Gladys Ave. Mr. Ostronik is equipped with both electric and acetylene outfits and is prepared to handle both shop and field work. He will feature a general commercial welding business, operating under the name of the Rudy Welding Works.

J. C. Dewey, owner and manager of the Arco Welding Works in Los Angeles, Calif., recently moved his equipment from 237 S. Figueroa St. to a new location at 3815 S. Main St. Mr. Dewey features automotive welding of all kinds, special attention being paid to starter-teeth work and the welding of motor blocks without removing the motor from the frame.

The Dallas, Texas, district sales office of the Republic Steel Corp. has been closed and removed to 2322 Gulf Building, Houston, Texas, N. J. Clarke, vice-president in charge of sales, announced recently. R. E. Lanier, district sales manager, and his present staff will be in charge of the new Houston office.

A 14-mile welded 4-in. pipe line will be constructed in the near future in Crockett County, Texas, to convey natural gas to the town of Ozona. The gas for this line originates in the oil and gas field northwest of Ozona. Completion of this work is scheduled for July 1st.

The H & L Iron Works, of 2062 Laura Ave., in Huntington Park, Calif., recently opened for business, specializing in the manufacture of welded equipment of various kinds for earth moving, grading, etc. Both the electric and oxyacetylene processes of welding are employed.

Construction operations employing a great amount of welding both by the electric and oxyacetylene processes, are under way in the erection of an 800-barrel oil refinery at Great Bend, Kan. The plant is being built for the Falcon Refining Co.

The Well-Done Welding Service, Champaign, Ill., are installing a furnace for preheating and annealing castings preparatory to and after welding. This shop has recently added a complete blacksmithing department.

Elbert Russell and A. F. Holder have formed the Universal Welding Co. and have leased a shop building at 109 S. Denver St., Tulsa, Okla., to specialize in both acetylene and electric welding with particular attention to garage work.

The O. J. Baillie job welding shop, formerly located at 125 E. Wood St., has moved to 173 N. Jackson St., Decatur, Ill. There will be about three times the former floor space available at the new location.

Whelite Distributors, formerly located at 1737 E. 7th St., Los Angeles, Calif., are moving their headquarters from that location to 5623 Sunset Blvd., in Hollywood.

The Kiefer Welding Works, Kiefer, Okla., has been formed by J. D. Amos, formerly with the Texas Bit & Boiler Works at Gladewater, Tex.

The Mayfield Boiler Shop, capital $5,000, has been incorporated at Ardmore Okla., by Elmer Mayfield to specialize in boiler repairing and welding. Mr. Mayfield was formerly located in Oklahoma City.

The Boiler Specialty Co. has been established at Houston, Tex., by M. G. Miller to handle supplies and do repair work on oil-field and industrial boilers, in connection with which welding will be extensively used.

The North Main Machine & Welding Co. has been formed by Cecil Caldwell and Charles Gadd to operate a shop at 2006 N. Main St., Houston, Tex.

Ralph W. Bannar has rejoined the sales force of Root, Neal & Co., Buffalo, N. Y., distributors of welding equipment and supplies. The affairs of the Bannar Welding Supply Co., Inc., with whom Mr. Bannar was formerly associated, are being brought to a close.

Eugene C. Miller and Clifford T. Miller, both with 15 years' experience in the manufacture and repair of oxyacetylene equipment, have formed the Miller Equipment Co., at 120 Opera Place, Cincinnati, Ohio, where they are engaged in the handling and repair of this type of equipment.

The Welding Engineering Co., 2872 North 41st St., Milwaukee, Wis., recently sold two rebuilt arc welders to Geo. E. Braun, of the Sherburn Welding & Body Works, Sherburn, Minn., and to Olaf Haarvei, of the Alma Welding & Cutting Co., Alma, Wis. Both of these machines were made into gas-engine portable trailer sets.

Mike Bohachek, of the North Ave. Welding Co., 2602 W. North Ave., Milwaukee, Wis., has bought a P & H Hansen motor-driven welder, 200 amperes, from the Welding Engineering Co., Milwaukee, Wis.

F. L. Maxwell, formerly welder for the Elizabeth garage, is now associated with the Kahls blacksmith shop, Elizabeth, Ill.

The Service Welding Co., of Freeport, Ill., are building a hydro-glider type of boat for their own use in nearby waters this summer.

Chas. Van Buskirk, formerly a partner in the Douglas Street garage, has opened a job welding shop under his own name at 9 W. Douglas St., Freeport, Ill. Mr. Van Buskirk has gas-welding equipment and a portable arc-welding unit with gas-engine drive.

The North Side Plumbing & Heating Co., 2230 N. Clinton St., Ft. Wayne, Ind., recently added a complete Prestoweld welding and cutting unit.

Roy A. Henderson, proprietor of the Als Welding Shop, Ft. Wayne, Ind., has moved the shop to 2306 Oliver St., the former location being 919 Goshen.

Hoar Bros. & Holdefer, of Oskaloosa, Iowa, have moved their job welding and machine shop from 214 North A St. to 315 First Ave. West. The new location has approximately three times the floor space of the old.

Orville Smith has opened a job welding shop at 214 North A St., Oskaloosa, Iowa.

J. T. Kinney has been appointed sales manager of the Electrox Co., Peoria, Ill. In addition to being in charge of sales, he also is in charge of the production of both oxygen and acetylene.

The Joseph Turk Manufacturing Co., Bradley, Ill., have added a considerable number of welders to their pay roll. It is reported that they are introducing to the trade an all-welded shower-bath unit which sets into any home, doing away

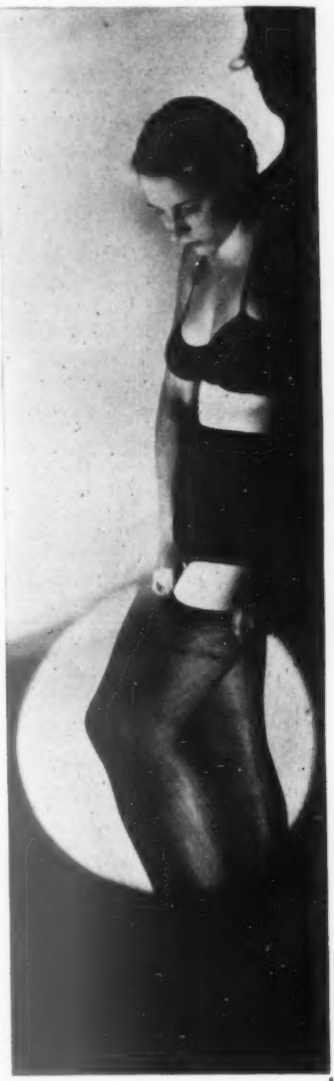
Hosiery illustrated purchased retail, includes profits to maker, jobber and retailer.

Acetylene purchased in tanks includes profits and many extras often amounting to 75%.

Cut Costs—Save Money

HARRIS *Red Head* GENERATOR

This portable generator has everything—is 4 ft. high; makes about 100 cu. ft. pure acetylene gas per charge; is approved by Underwriters' Laboratories; Factory Mutual Ins. Co., and New York City Fire Dept. This generator will automatically produce acetylene right on the job at minimum cost. Price only $50.00.



100% Dividends—Generator pays for itself in 12 months where one 300 ft. tank of acetylene, purchased at 2½c per ft., is used monthly.

400% Dividends—Generator pays for itself in 90 days where 4 tanks as above are used monthly.

KEEP UP WITH THE TIMES! Get the complete story from new catalogue telling of this money-saving plan, also showing the most complete line of welding and cutting apparatus ever offered. Free upon request.

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with the usual inconvenience of muss incident to installing as happens with the usual built-in unit.

G. B. Myers, who operates the Burlington Electric Welding Works, at Burlington, Iowa, has received a contract from the Burlington Sand & Gravel Co. to weld all piping on their river sand pump barge, which is being overhauled.

The Princeton Gas Co., Princeton, Ill., are converting their plant from coal gas to water gas, which entails considerable welding in connection with piping. By using welding and cutting, they have been able to reclaim and use in the change-over much of the old pipe, whereas if threaded connections were used all new pipe would have been necessary. This change necessitated purchasing several large tanks, which were obtained from the Chicago Bridge & Iron Works and were of welded construction.

The International Harvester Co. is constructing an implement factory at Moline, Ill. The new factory will represent an investment reported to be $200,000 and is expected to be in operation by fall, employing approximately 500 men.

The Roth Packing Co., Waterloo, Iowa, are planning to start immediate construction of a $60,000 lard-rendernig plant in which some welding will be used.

An order for 400 welded brackets for the city of Ottumwa, Iowa, has been received by W. E. Sprague, who owns a job welding shop in that city at 325 W. Main St. These brackets will be used for reinforcing the cornice on the city waterworks plant. These brackets will be fabricated from ¼x1¼-in. stock, of which approximately a ton and a half will be used. Each bracket will have five welds.

· CLASSIFIED ADS ·

Help Wanted—75c per line, minimum 4 lines. Jobs Wanted—4 lines free. Other Ads—$1.00 per line, minimum 4 lines. Count 8 words to line. Add 6 words for keyed address.

FOR SALE

For Sale—Four No. 2 Omaha Electric Arc Welders. Good condition. Price reasonable. Cash or terms. Address Box 112, The Welding Engineer.

For Sale—Bargains—Arc Welders, gasoline or electric drive. 30 days' trial. Terms if desired. Write Ken's Equipment Exchange, Box U 561, Troy, Ohio.

Standardized Cutting and Welding Tips, interchangeable with various types of torches; also apparatus, accessories and complete outfits. Prices unbelievably low. High quality and workmanship. Write for catalog. The Alexander Milburn Company selling on behalf of TIPS, INC., 1416-18 W. Baltimore St., Baltimore, Maryland.

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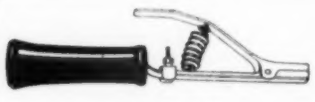

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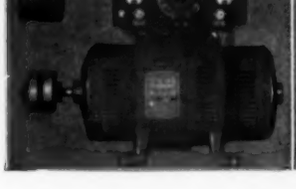
Sales Engineer or Agency Wanted—For exclusive sale of a high-quality, well-established, nationally advertised line of arc welders in the New York territory. Must have had experience in welder field. Give complete information. Replies held in confidence. Address Box 113, The Welding Engineer.

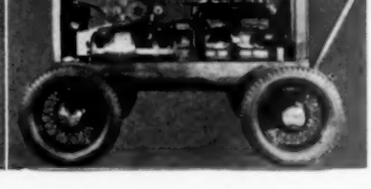
Electrical Engineer—A-1 knowledge of welding. Foreign experience desirable. State present or last employment. Reply confidential. Address Box 114, The Welding Engineer.

POSITIONS WANTED

Welding Designer and Coordinator—Man with 8 years' experience with large manufacturer of large and small parts, as a welding executive, desires position involving the coordination of welding processes and design, with a view to economy in production and saleability of product. Intimately acquainted with procedure, advantages, and limitations of metallic and carbon arc, gas, atomic hydrogen, and resistance welding, manual and automatic. G. N. Wright, care of The Welding Engineer.

Graduate Engineer—18 years' experience in structural-steel work, with 6 years in own business specializing in welded construction. Ability covers designing, detailing, selling (for both riveting and welding), selecting and testing welders, and supervising shop fabrication and field erection. Paul B. Covey, Manchester, N. H.





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